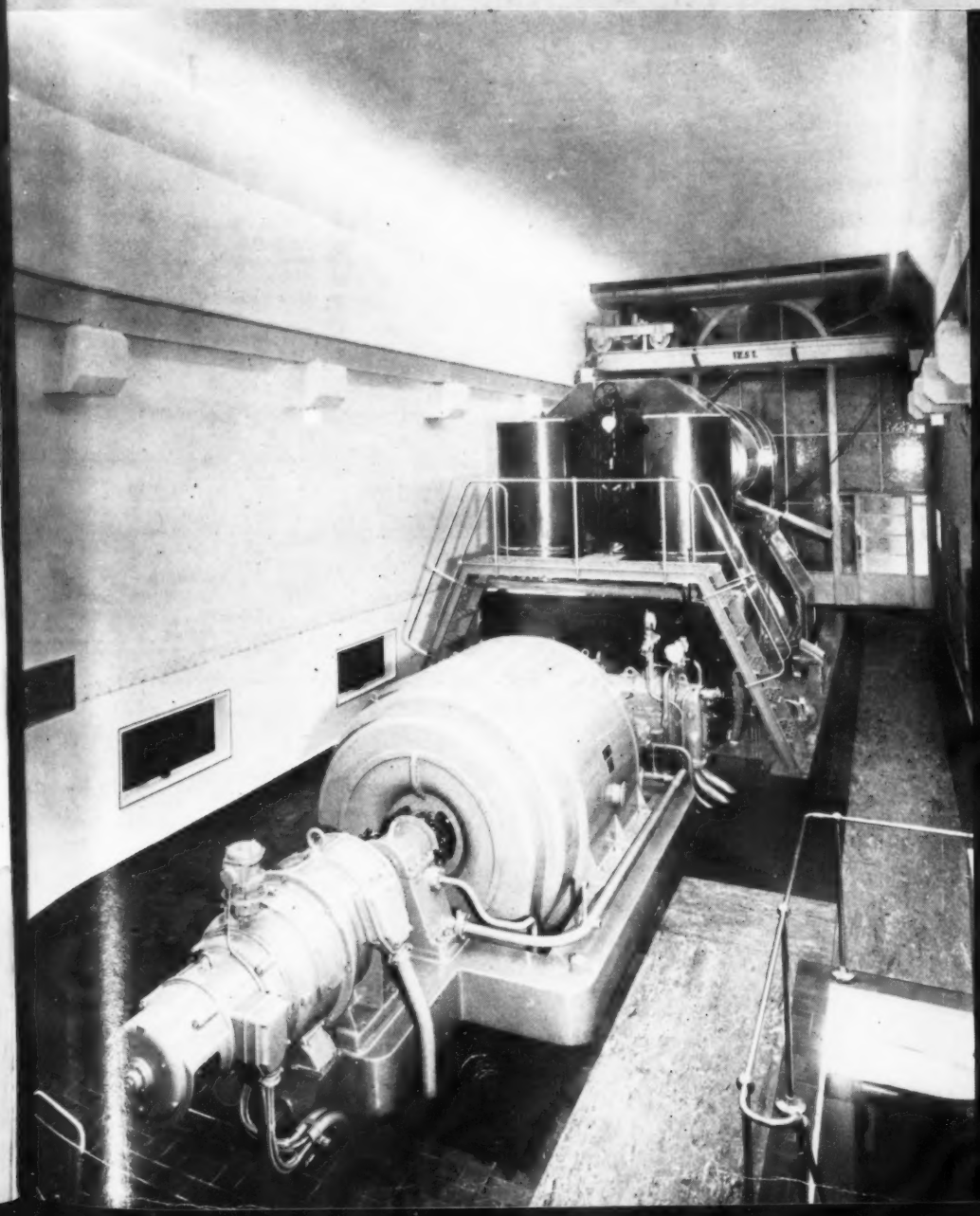
PUBLIC LIBRARY

POWER

FEBRUARY, 1944

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY



Bombproof plant, Neuchatel, Switzerland, houses 4000-kw gas turbine, only one built solely for power generation

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Power Handbook — This second part, like the first, presents simplified, easy-to-use facts and figures for power men, but covers more specific subjects, such as feedwater chemistry, combustion, steam generation, turbines, diesels, refrigeration, compressors, fans, heating and air conditioning. Page 71

How to articles — Maintaining fire extinguishers, pa... 66; reducing draft-fan ... sion, page 70; pr... shaft-current t... 103; fittin... ton ring... ing lin...

ONE OF A SERIES OF SUGGESTIONS F...

[redacted] CARLOADS LEND LEASE

Total Weight Shipped [redacted] Tons
Cargo Space [redacted] Cu. Ft.

You, who have purchased Hydrojet Ash Handling Systems, Hydrovac Dust Handling Systems, Hydroseal Abrasive Handling Pumps, and Hydrobin Dewatering Ash Storage Tanks know that even one carload will provide equipment to handle a lot of ashes and dust. Then, you can imagine the ash and dust handling capacity of [redacted] carloads of these A-S-H products. . . . We admit that we feel "proud as Punch" about our equipment's being selected to help our allies, for we know it was chosen because they would not adopt a "Penny Wise—Pound Foolish" policy. . . . These "Lend-Lease" systems are being installed thousands of miles from [redacted]me without the supervision of our Engineers and by men who, perhaps, have never seen nor operated modern ash and dust handling systems. Installation difficulties or operating troubles obviously could not be tolerated, for such costs might have to be measured in something more precious than money. . . . In these tragic days, the users of Hydrojet, Hydrovac, Hydroseal, Hydrobin, both here and abroad, are thankful for the durable, reliable quality of A-S-H products.

for Ash Handling

HYDROJET
HYDROVAC
HYDROSEAL
HYDROBIN

[redacted]HOFF CO., 227 S. 15th St., PHILADELPHIA 2, PA. Offices & Representatives in Principal Cities

"Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), February, 1944, Vol. 88, No. 2. Published [redacted]ber in December. Return postage guaranteed. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany, 1, [redacted]. 330 WEST 42ND STREET, NEW YORK, 18, N. Y. Entered as second class matter, August 25, 1936, at Post Office, at Albany, N. Y., under [redacted]S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of [redacted]New York, 18, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two years. Canada, $3.50 for one [redacted]British Possessions, 36 shillings per year. All other countries, $6.00 for one year, $9.00 for two years, 35c per copy.

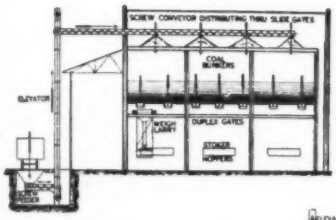
Your coal and ashes handling problem . . .

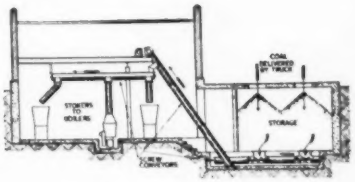
Manpower shortage?

Converting from gas or oil to coal?

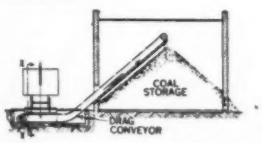
Old equipment?

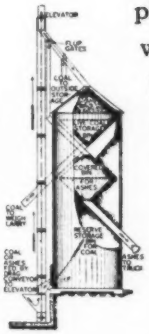
12 Typical Link-Belt solutions are illustrated

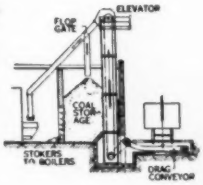


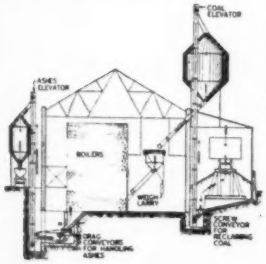


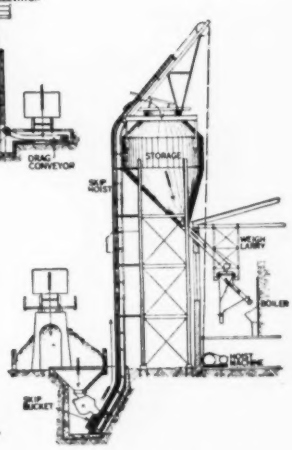
● Wartime exactions require revised thinking about coal and ashes handling. Fuel must be handled efficiently and man-hours saved in spite of stepped-up production. There is no one solution to the problem, so engineering skill and experience are needed in selecting the best type and arrangement of equipment to successfully meet each particular need. Whether your plant is large or small and no matter what your coal and ashes handling problem, there is suitable Link-Belt equipment to meet every requirement. Before you do anything else about it, talk over your problems with an experienced Link-Belt engineer. Send for Book No. 1510, "Solving The Problem of Coal and Ashes Handling in The Boiler Plant."

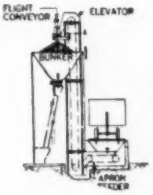


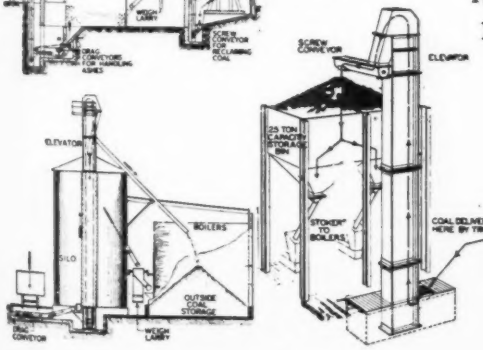


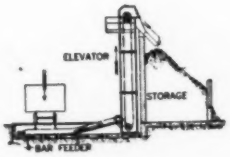


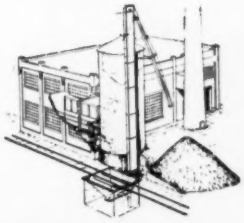












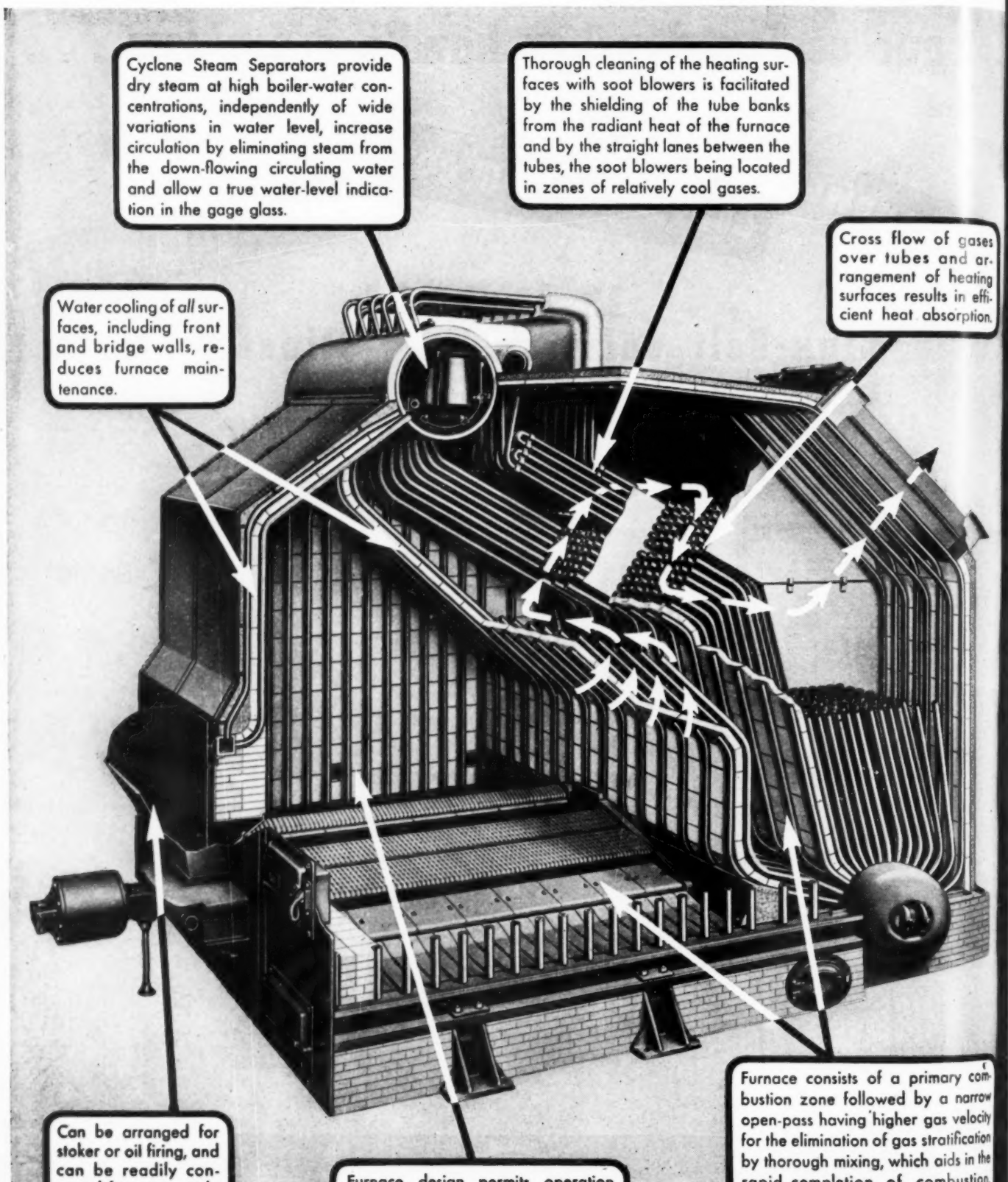
LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, San Francisco 24, Toronto 8. Offices, warehouses and distributors in principal cities.

9257-A

LINK-BELT

COAL and ASHES HANDLING EQUIPMENT


Cyclone Steam Separators provide dry steam at high boiler-water concentrations, independently of wide variations in water level, increase circulation by eliminating steam from the down-flowing circulating water and allow a true water-level indication in the gage glass.
Thorough cleaning of the heating surfaces with soot blowers is facilitated by the shielding of the tube banks from the radiant heat of the furnace and by the straight lanes between the tubes, the soot blowers being located in zones of relatively cool gases.
Cross flow of gases over tubes and arrangement of heating surfaces results in efficient heat absorption.
Water cooling of *all* surfaces, including front and bridge walls, reduces furnace maintenance.
Can be arranged for stoker or oil firing, and can be readily converted from one method of firing to the other.
Furnace design permits operation with low excess air, resulting in increased efficiency.
Furnace consists of a primary combustion zone followed by a narrow open-pass having higher gas velocity for the elimination of gas stratification by thorough mixing, which aids in the rapid completion of combustion. Complete combustion means SMOKELESS COMBUSTION.

B & W INTEGRAL

Small-Boiler Plants can secure these Large-Boiler Advantages

Plants requiring as low as 9000 lb. of steam per hour can now have the efficiency features indicated on the drawing and that were formerly available only in much larger boilers. Skillful engineering has incorporated these and other advantages in the design of the B&W Integral-Furnace Boiler in a way that maintains compactness, simplified operation, and low initial cost.

A large amount of water-cooled surface in the furnace permits wide variation in the grades of coal that can be burned successfully. Oil-fired units can be readily converted to stoker firing at small cost for brick-work changes. Coal-fired units can be as readily converted to oil firing.

Maintenance is reduced by complete water cooling of the furnace, which contains a minimum of unprotected brickwork. Even the upper front wall and roof are water cooled, as well as the bridge wall and side walls.

All pressure parts are readily accessible for inspection and cleaning. All the header handholes are accessible from outside the boiler. The steam-drum internal fittings are easily removed when necessary. The steel casing facilitates good housekeeping.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK

G-234T

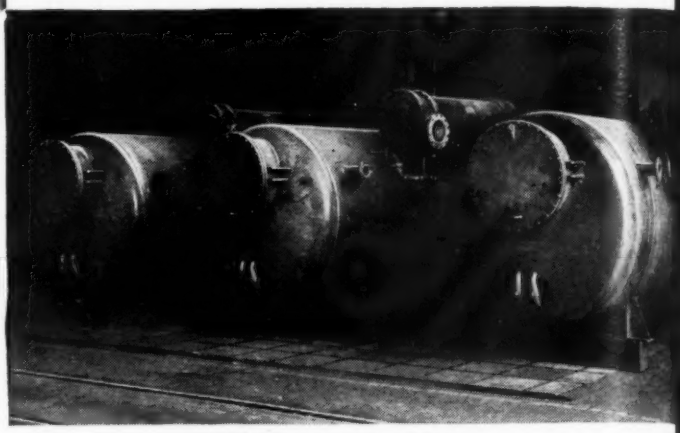
Complete details of this unit, including data on sizes available and space requirements, are given in Bulletin G-34 A sent on request.

URNACE BOILER

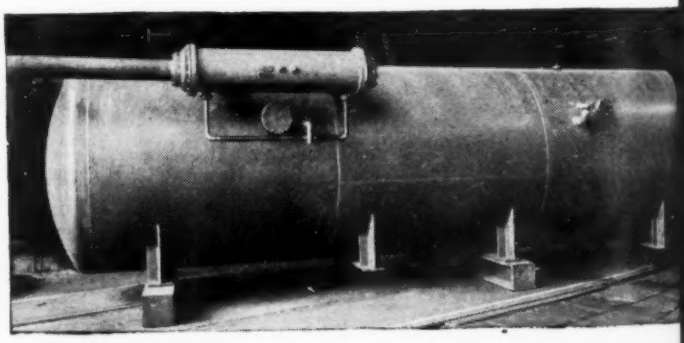
Elliott

This Elliott deaerating heater was built in sections instead of with the shell in one piece so that it would go through the only available opening (a window frame) in the power plant in which it was to be installed.

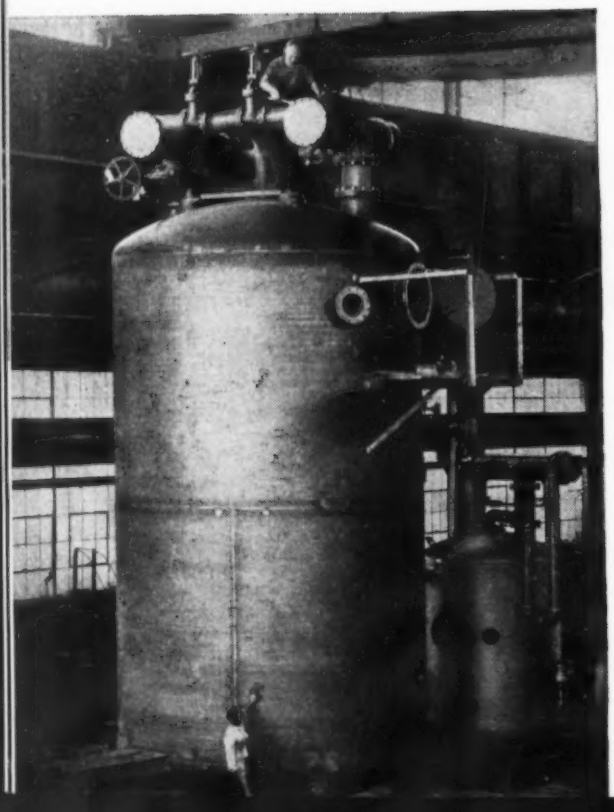
Typical medium-size vertical deaerating heater mounted on a horizontal storage tank. Vent condenser on side to save headroom



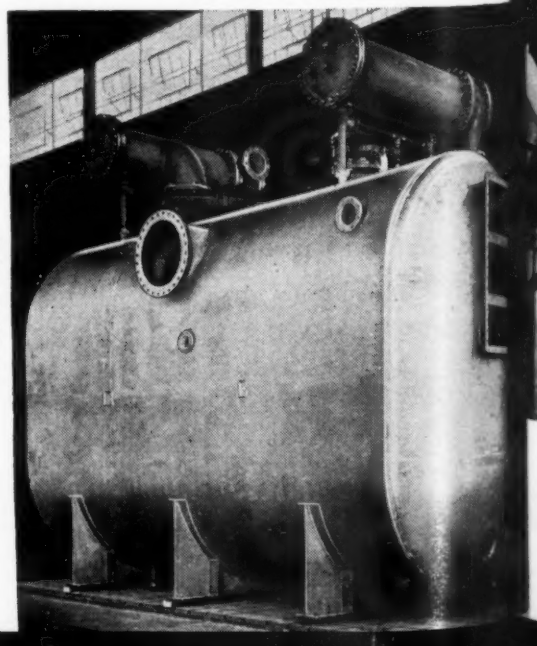
Standard horizontal deaerating heaters with special arrangement of vent condensers to cut down headroom.



A long horizontal unit especially designed to fit into appropriate space aboard a wartime floating power plant.



This 1,500,000-lb.-per-hr. deaerating heater was shaped to fit into limited width in a big utility station.



Two vertical deaerating heaters. Unit at left has twice the capacity of the one on the right, and eight times the storage capacity. It is about as big as can be placed in a railroad car — 12 ft. by 27 ft. high.

engineering gives tailored fit in

Deaerating Heaters!

Hardly two deaerating feedwater heater installations are alike in physical characteristics. These units must be fitted to many factors other than the required capacity and operating conditions. The desired amount of storage may mean a large single-shell unit, or a heater with a separate storage tank. Space limitations and available access to buildings must be given first consideration. Railroad clearances limit the size and shape of large units. And with each variation in shape, the critical design areas, volumes, tray and water distribution, piping arrangements, and controls must be proportioned for dependable operation and maximum feedwater heating and deaerating performance.

Obviously you cannot take a standard deaerating heater "off the shelf" and set it to work. It has to be designed, tailored, to fit the conditions. How Elliott engineers fit Elliott deaerating heaters to their jobs is shown in the photos on these pages.

•

If you have a heater problem, particularly one that looks tough, talk it over with these Elliott specialists.

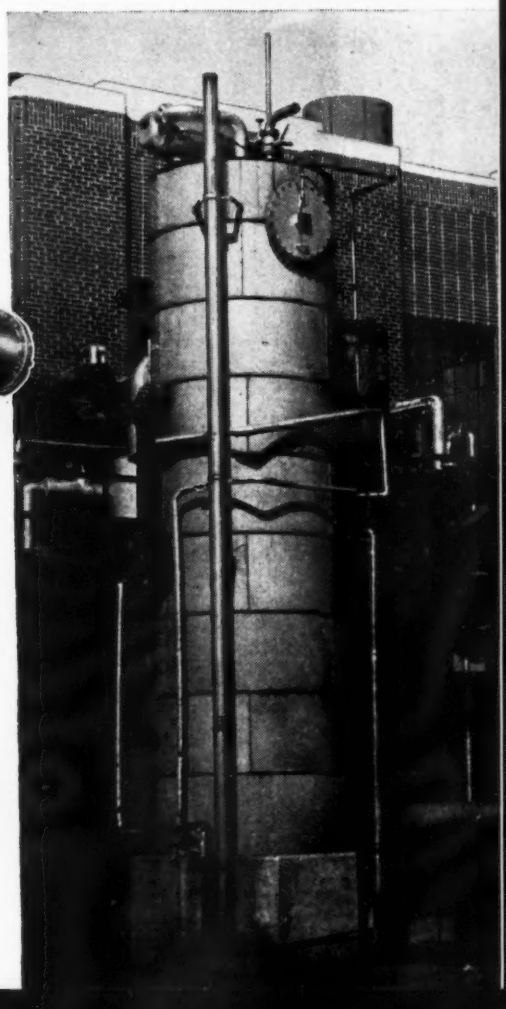
ELLIOTT COMPANY
Deaerator & Heater Division, **JEANNETTE, PA.**
DISTRICT OFFICES IN PRINCIPAL CITIES

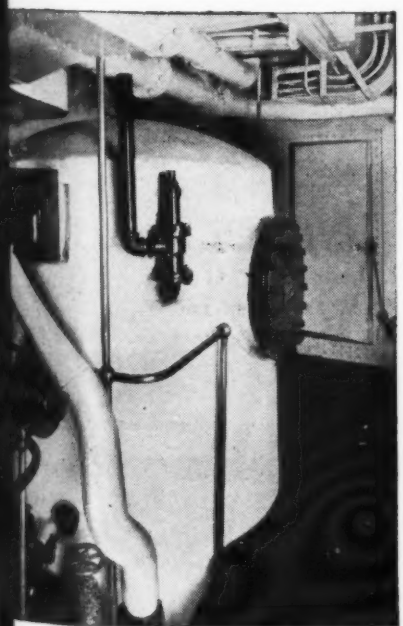
A star has been added to the Army-Navy "E" flags flown by both the Jeannette and the Ridgway plants of Elliott Company.

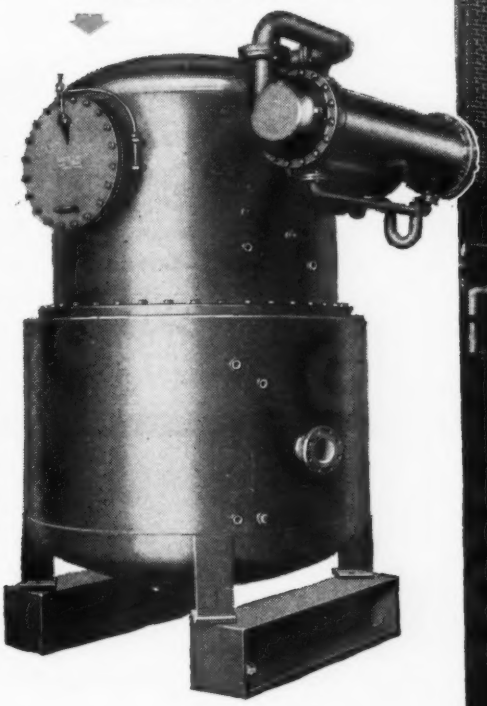
N-975

For outdoor installation, this Elliott deaerating heater was made to accommodate large water storage underneath the deaerating heater proper.

Low headroom deaerating heater, for installation in limited space in existing building, constructed so that lower part of unit could be put in place and the upper part slid over it. Vent condenser mounted on side.







Deaerating heaters for installation on board ship are built with the utmost compactness, usually with internal vent condensers, as illustrated.

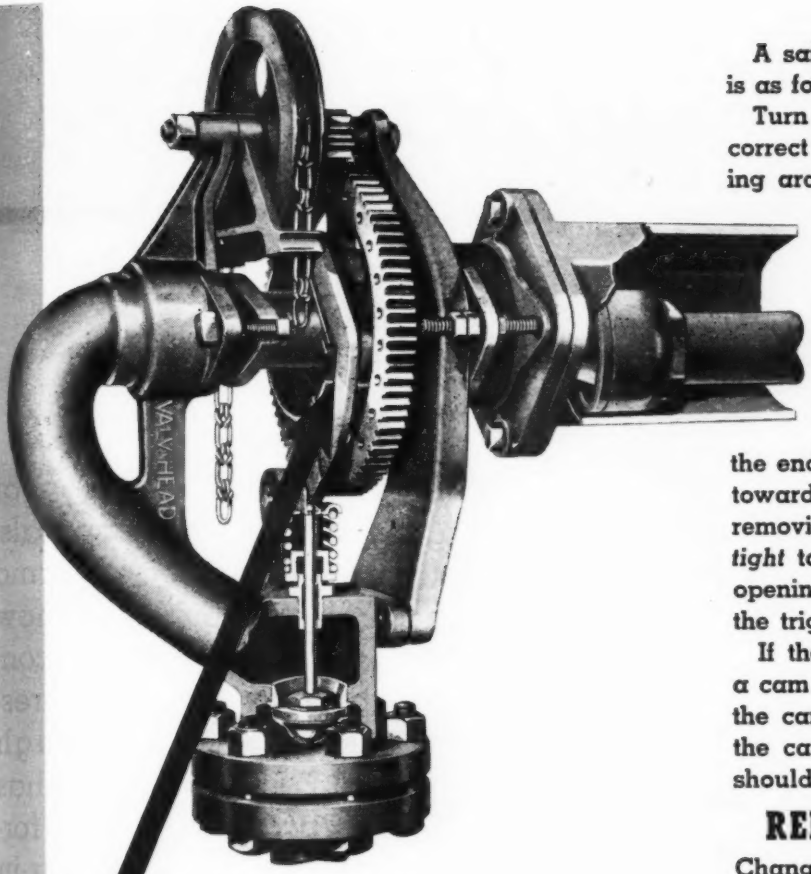
FOR BETTER BOILER CLEANING

Check SOOT BLOWER CAM SETTINGS PERIODICALLY

Position of cam and trigger of Diamond G9B Soot Blower just prior to beginning of blowing. Clockwise rotation of the cam will depress the trigger and open the valve.

Trigger is now completely depressed and valve is open. Length of cam determines blowing arc as valve remains open until trigger slips off other end of cam.

THROW YOUR *Scrap* INTO THE FIGHT



A MOST IMPORTANT PART of the Diamond G9B Soot Blower is the cam which opens and closes the valve—and which regulates the pressure where reduced pressure blowing is employed.

In any case, the cam determines the blowing arc. If it is not properly set, the blowing arc will be wrong. If the arc is too long, steam is wasted, and tubes, headers, baffles, etc., may be injured. If the arc is too short, effective cleaning is impossible.

Cams on all G9B heads should be examined periodically for tightness and correct position. Drawings furnished for installation of Diamond Soot Blowers show the correct blowing range for each unit. It is important that nozzles should not blow directly into boiler headers, drums, baffles, etc., at close range with full pressure.

A safe method for checking or setting cams is as follows:

Turn the element so that the nozzles are in correct position for the beginning of the blowing arc. With the head in this position, place the opening end of the cam (the beveled end with the slot in it) in contact with the end of the trigger. Then attach the cam to the gear wheel by means of two cam bolts made up handtight, and turn the head until the nozzles are in correct position for the end of the blowing arc. Mark the cam directly at the end of the trigger, and cut it off 2¼" back toward the beveled end from this point after removing it from the gear wheel. Then bolt *tight* to the gear wheel, making sure that the opening end of the cam comes in contact with the trigger first.

If the blowing arc is so short as to require a cam 3" long or less, cut off only the face of the cam and leave at least five bolt holes in the cam flange. Not less than two cam bolts should be used.

REDUCED PRESSURE BLOWING

Changes in baffles, etc., may require reduced pressure blowing through part of the arc. Special cams should be used to provide any needed sequence of reduced and full pressure blowing.

360° ARC BLOWING

Some conditions require a unit to blow through the entire revolution. In such cases, 360° cams and triggers should be used.

GET ***MORE*** OUT OF THE SOOT BLOWERS YOU HAVE

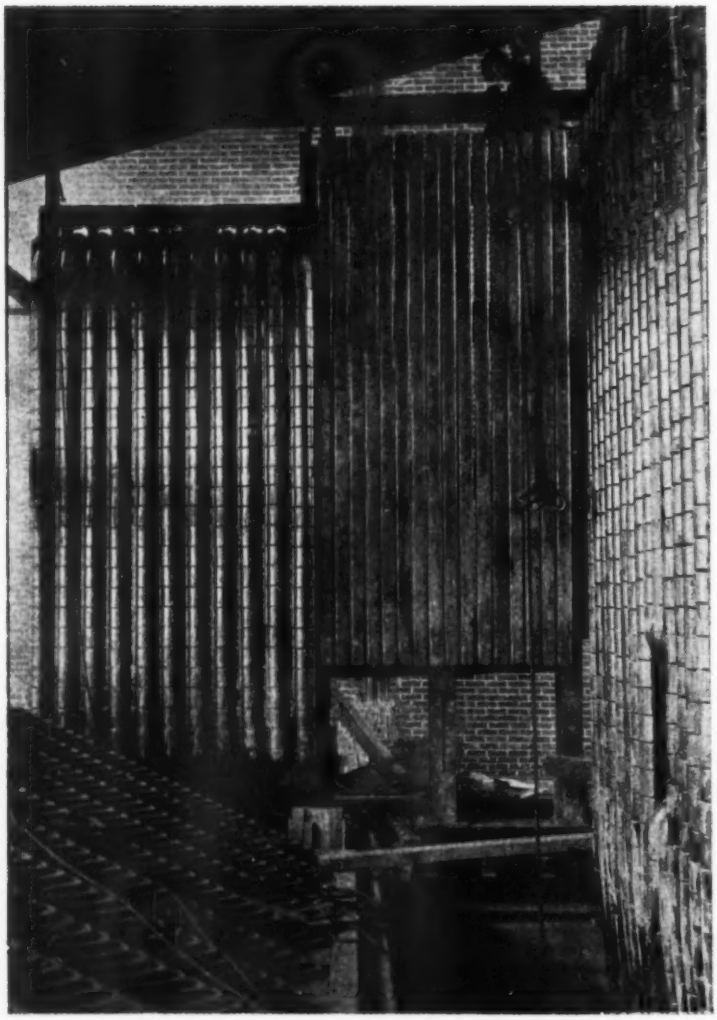
War demands often make it difficult for us to supply new blowers or repair parts as promptly as we'd like. Careful maintenance will prolong the useful life of the blowers you have. This booklet tells you how to maintain, adjust and repair Diamond G9B Soot Blowers. *Write for a copy.*

DIAMOND POWER SPECIALTY CORP.

DETROIT • MICHIGAN

DIAMOND SPECIALTY LIMITED • Windsor, Ontario

Blazing THE



Waterwalls and radiant superheater in a 1276 H.P. boiler of a large public utility plant built in 1926.

Intelligent application of engineering fundamentals, motivated by research, and tempered with the "know how" of long experience constitute the keystone of progressive engineering. Through the years Foster Wheeler has successfully applied this formula; thereby contributing in no small measure to significant advances in steam generator design. Three examples prominent in universal service are the "individual" external economizer, radiant type superheaters and water-cooled furnace walls.

It is well known that with improved combustion methods and the increase in the size of boilers, higher furnace temperatures resulted in prohibitive maintenance costs on brickwork. Foster Wheeler tackled this problem and was among the first to replace refractory walls with water and steam cooled surfaces, making the first installation of water cooled furnace walls in 1922.

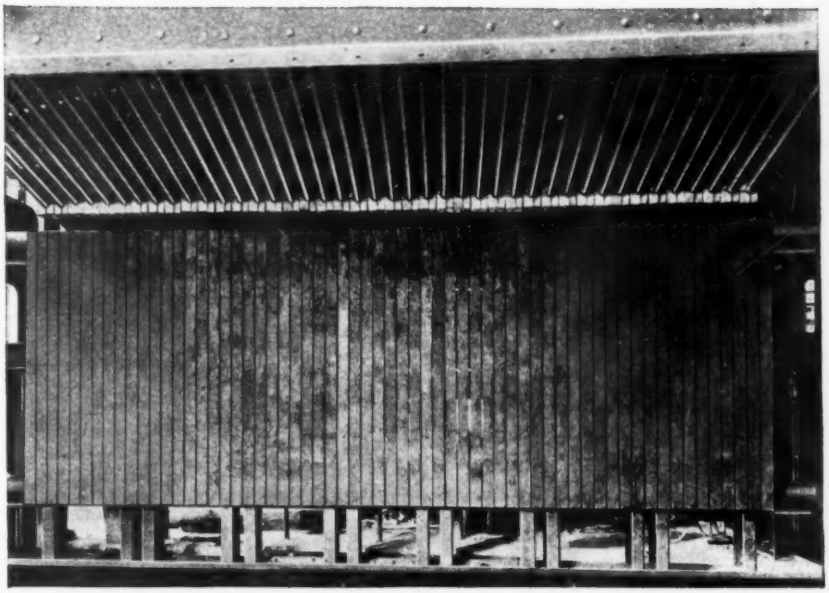
FOSTER WHEELER CORPORATION
165 BROADWAY
NEW YORK 6, N. Y.

FW FOSTER

ENGINEERING TRAIL

To utilize the high heat transfer rates of radiant heat in furnaces and the protection which steam cooled walls afford refractory, Foster Wheeler developed and installed the first radiant superheater in 1917. This advance in furnace practice was the forerunner of combination superheaters which insure constant final steam temperature over wide fluctuations of load.

Foster Wheeler is a Three-Star winner under the U. S. Navy Board of Awards for production.



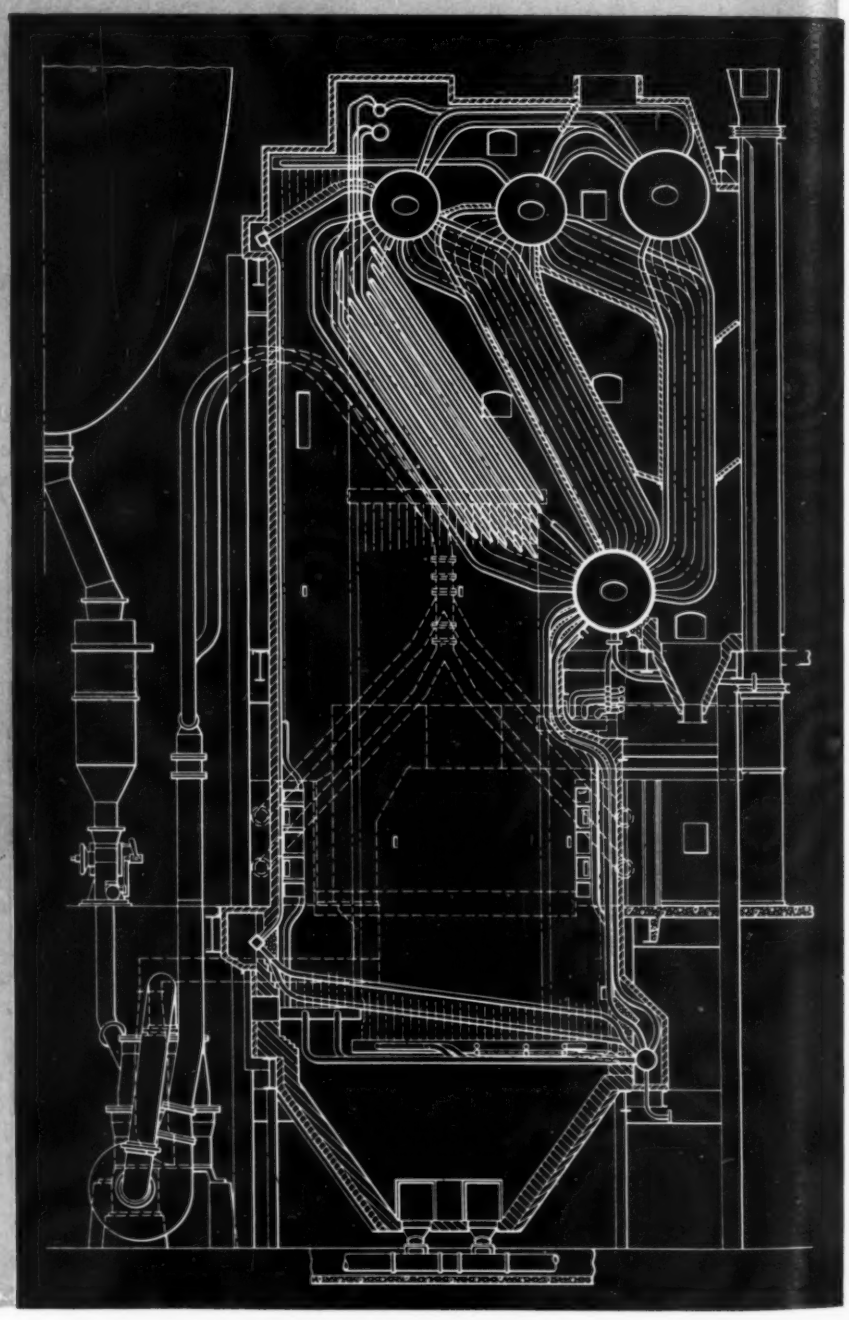
Radiant superheater designed for 60 deg. superheat in a 600 H.P. boiler of a New England industrial concern. Installed in 1925.

3416 sq.ft. extended surface economizer installed in 1925 at a Mid-western industrial plant.

Today the vast majority of large steam generators are equipped with individual economizers. Twenty-four years ago that was not the case—it was then that Foster Wheeler installed the first extended surface, forced water flow, high pressure, high gas velocity economizer as an "individual" unit to service one boiler. This economizer was deliberately designed for high draft loss on the economic principle of maximum work from minimum economic surface. Foster Wheeler has installed more than 4,500 extended surface units—indisputable proof of efficient service.

WHEELER FW

WHEN PEAK LOAD RATING



One of two duplicate C-E Units responsible for the remarkable record related on the opposite page. Capacity — 125,000 lb of steam per hr (maximum continuous). Design Pressure — 700 psi. Total Steam Temperature — 750 F.

BECAME CONTINUOUS DEMAND

In 1937 a large mid-west automobile company installed 2 C-E Pulverized-Fuel-Fired Units in one of its plants. These units were designed to produce, at maximum continuous rating, 125,000 lb of steam per hr with peak ratings up to 170,000 lb per hr for 4 hours. This they did, with complete satisfaction, for more than three years — and then came War.

Rapidly the plant was converted, 100 per cent, to war work. More — more of everything — was the order of the day, including, of course, more steam. How well the C-E Steam Generating Units responded is evidenced by the fact that they were soon *averaging* 170,000 lb of steam per hr *continuously* — and at a monthly efficiency of 84 per cent.

Continuously has added significance for not only had *peak* rating become *continuous* rating but the availability of these units has been better than 98 per cent for the past 3 years — less than 2 per cent forced outage.

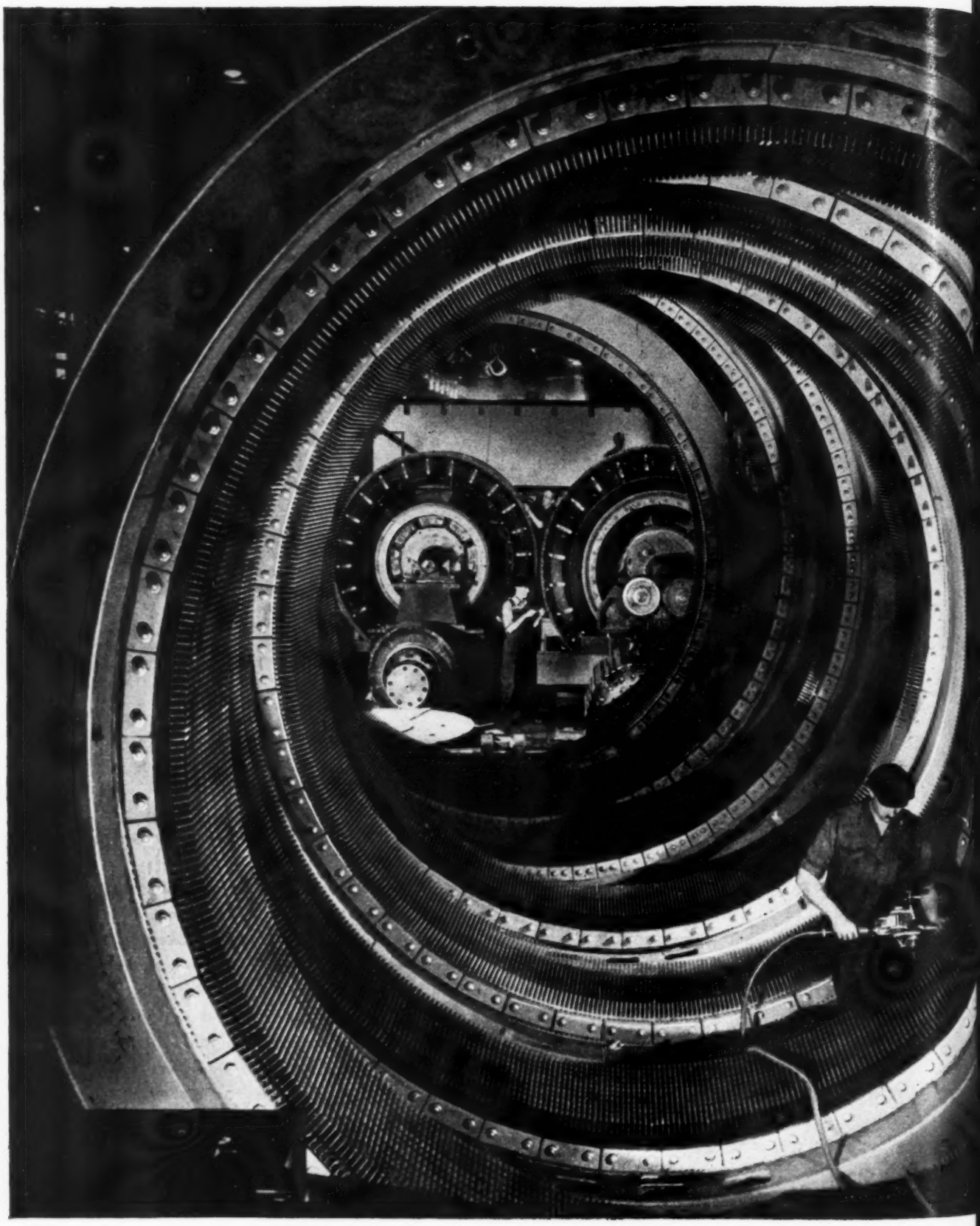
Thus the extra values in C-E design and construction are demonstrated again. Such performance repeated in many *war* plants has established the ability of C-E equipment to meet every demand with consistent dependability. You can assure this quality of performance for your *peace time* steam needs — Specify C-E.

A-772

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

Canadian Associates: COMBUSTION ENGINEERING CORPORATION LIMITED • Montreal • Toronto • Winnipeg • Vancouver



TEXACO

TEXACO

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT — C

Framing 54,000 hp.

As these seven large slow-speed motors are placed in service, Uncle Sam will have an additional 54,000 hp. for his war effort.

The wartime use of motors of all sizes, together with heating and lighting, has produced the greatest electrical load in history. As an aid in carrying the load, power plants everywhere are lubricating Diesels, turbines and steam engines with Texaco.

In steam turbines, for example, *Texaco Regal Oils (R & O)* keep lubricating systems clean, bearing temperatures normal, governor action smooth and sensitive. They free themselves rapidly from air and water, and are highly resistant to gum formation and sludging. *They are rust and oxidation inhibited.*

So effective have Texaco lubricants proved that they are definitely preferred in many fields, a few of which are listed below.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States. The Texas Company, 135 E. 42nd St., New York 17, N. Y.

THEY PREFER TEXACO

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

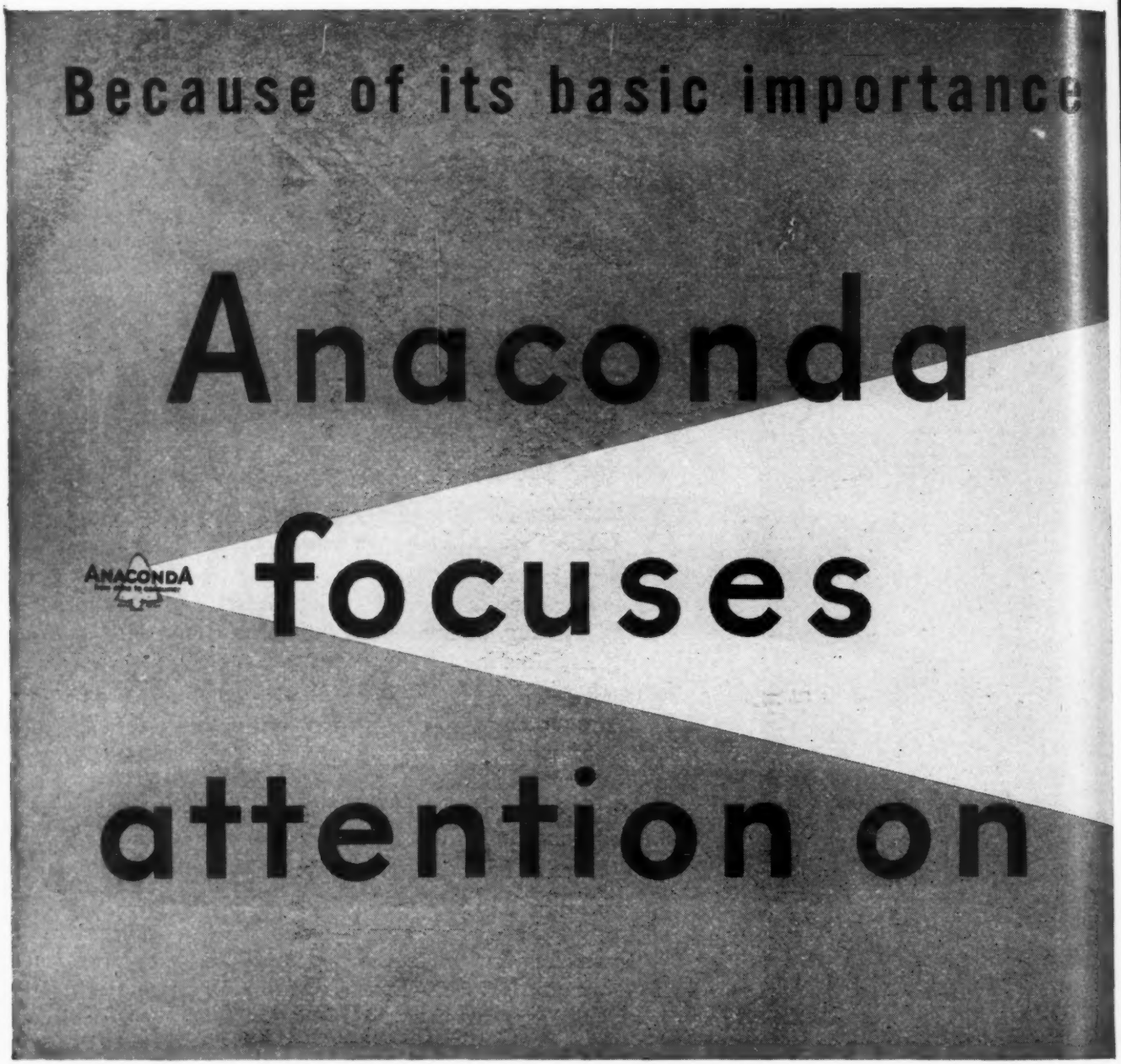
★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

REGAL OILS

FOR ALL TURBINES

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



Nothing is more basic in furthering the interests of the electrical industry as a whole—and of each individual branch—than the promotion of electrical wiring. This has long been the number one belief with Anaconda Wire & Cable Company.

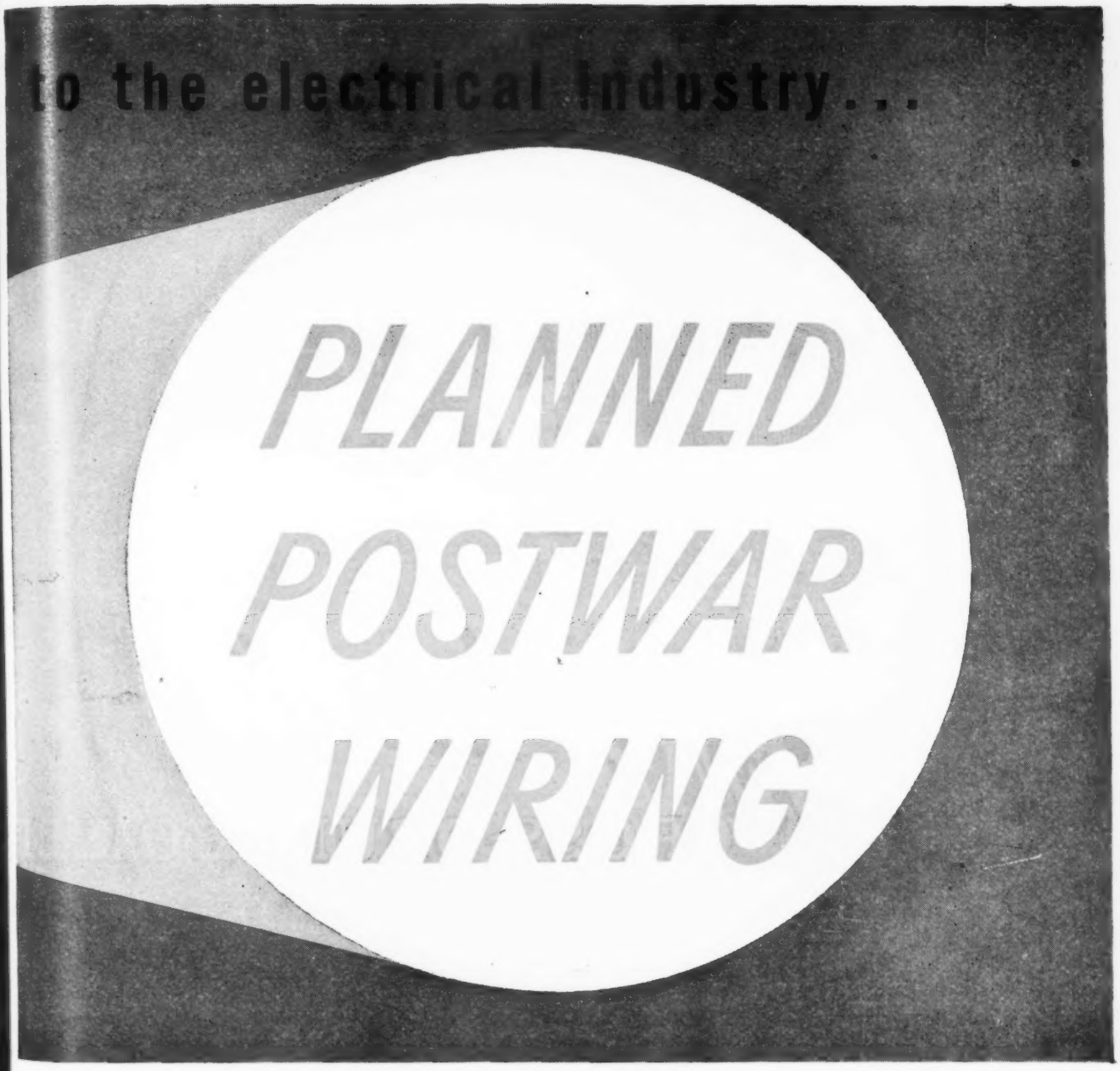
THE PAST

You probably recall the "Electrical Modernization" campaign of Anaconda prior to the war. It helped stimulate national interest in better wiring for Industry and helped to prepare Industry to meet the challenge of war production.

THE PRESENT

A more recent example is the "Preventive Maintenance" campaign developed by Anaconda engineers to meet wartime conditions. Based upon practical methods of conserving electrical circuits and equipment, it is being widely used.

Electrical Wires and Cables of Copper are the Life Lines



THE FUTURE

Today, the time is ripe for another step forward in furthering adequate wiring. We believe we can render a constructive service to the electrical industry and to business in general through a national campaign promoting the importance of *postwar* wiring.

Its objective will be to stimulate *advance thinking* about adequate wiring...to drive home to industry, municipalities and home owners the vital necessity of including PLANNED WIRING IN EVERY POSTWAR PLAN!

THE IMPORTANCE

Obviously, more and better wiring will have to come *ahead* of tomorrow's more efficient industrial production . . . city improvements . . . new products . . . finer appliances . . . more livable homes. The wider the recognition of this, the better business for everyone . . . utility, contractor, wholesaler, manufacturer.

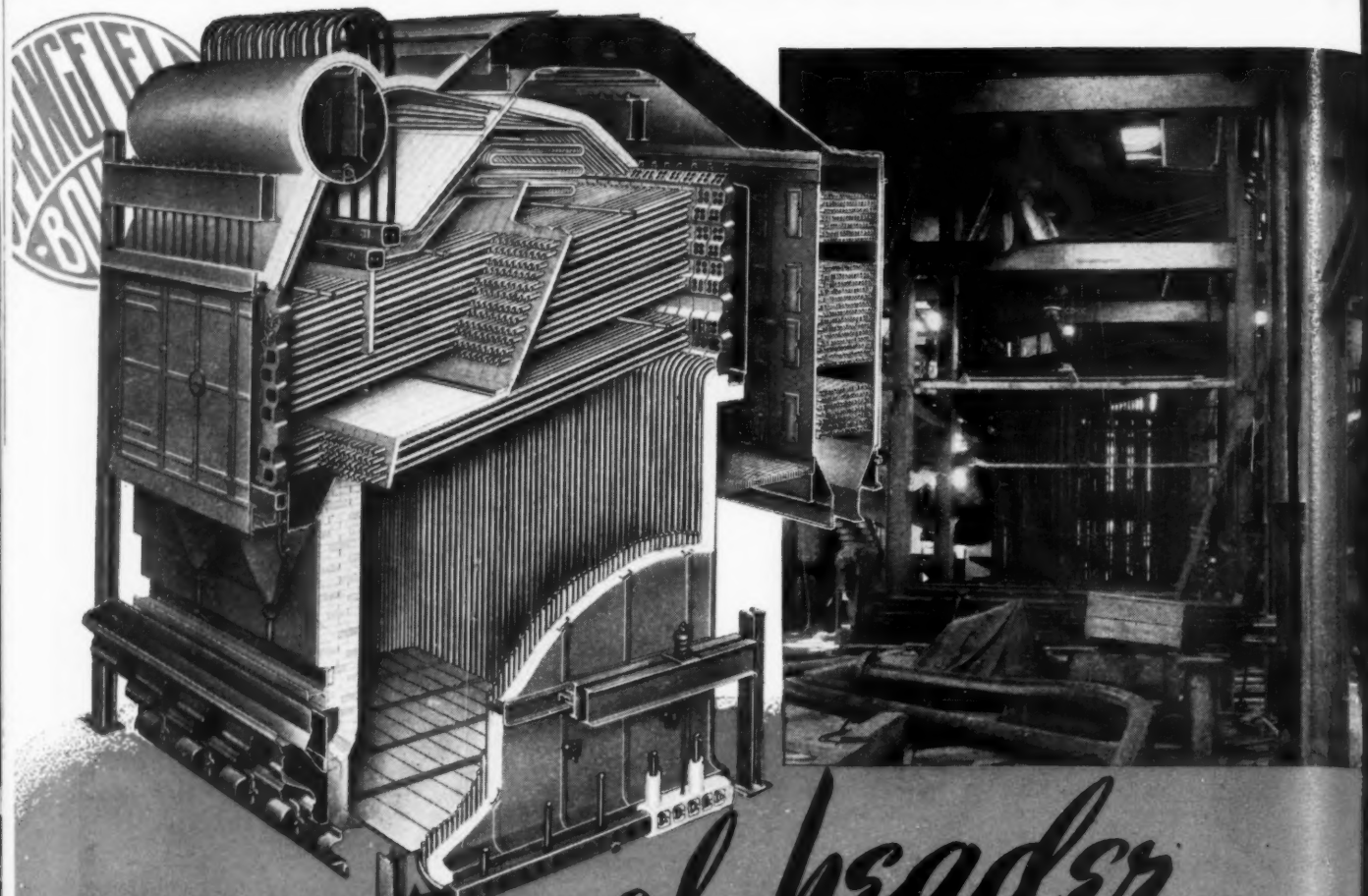
And now—in advance—is the time to lay the foundations. Postwar planning is gathering momentum. *Unwired* planning will benefit no one. *Planned wiring* will help everyone. 44227

of our Nation

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities



Sectional header... CROSS-DRUM BOILER

...meets wide range of local conditions

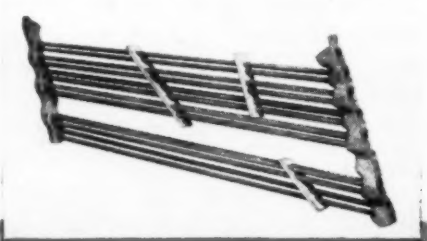
THE sectional header, cross drum boiler, as designed and built by Springfield is widely favored for manufacturing plants as well as central station use.

One reason for this is that the Springfield variation of this type of boiler is flexible enough to be economically adapted to a wide range of fuels, water, space, load, and other local conditions.

Operating reports, on a wide range of fuels, show that Springfield units develop unusually high efficiencies as proved by low exit gas temperatures; through using smaller tubes, staggered tube groupings, permanently tight baffle construction, and well integrated overall design.

"Less outage for maintenance" is a common comment on Springfield installations. Controlled circulation with delivery to the steam drum above the water level gives this boiler ability to produce dry steam and handle rapidly changing loads. Water conditions should be carefully controlled in any modern boiler plant but this type of boiler is less sensitive and affords additional protection when water conditioning "slips". Larger and fewer handhole openings reduce the time and cost of cleaning, inspection and repair. Soot and ash cannot lodge on headers and drums. All parts are readily accessible.

In replacing obsolete boilers, it is often desirable to install larger capacity units without extensive building changes. Springfield boilers are lighter and more compact than other designs, and are readily adaptable to restricted space requirements. Pitch of tubes may be varied from 15 to 25 degrees to suit local conditions. High capacity water walls increase furnace capacities.



Because of factory assembled sections and single drum construction, from 30 to 60 days are saved on erection time. Less brickwork is required, and cross tube baffles are delivered in place. Complete drawings and patterns are available to produce duplicate units of many of the great number of modern Springfield generating plants built in recent years.

★ ★ ★

Springfield boiler installations range from 5,000 to 450,000 lbs. per hour capacity; and from 75 to 750 psi pressure. Contracts taken for complete steam generating units. Write for information. **SPRINGFIELD BOILER CO., 1953 E. Capitol Ave., Springfield, Ill.**

SPRINGFIELD

STEAM GENERATING UNITS

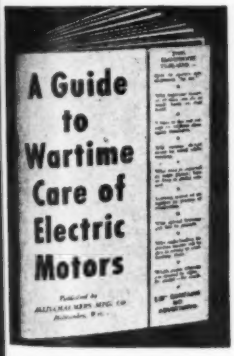
SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

FIRST AID FOR MOTORS

MOTORS RUN A FEVER? No wonder if they do more often today. They're working *3 and 4 times* as many hours as in peace!

Wartime conditions demand you diagnose motor ailments *quickly* ... remedy the trouble at once. At right are but few of the many diagnoses found in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors". In maintenance as in war, *attack is the best defense*. This book singles out the 9 main enemies of electric motors . . . tells you how to get them *before* they get your motors!



Over 100,000 copies already in use.

Write today for your *free* copy. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

SYMPTOMS YOU CAN *SEE*

Symptom	Possible Causes	Cure
1. Excessive sparking or flashing at brushes. Blackened commutator.	Rough commutator.	Sand or turn down, depending upon depth of surface roughness.
	Low bar on commutator.	Grind or turn down balance of commutator.
	High bar on commutator.	If extreme, lower with mallet, tightening clamping ring. Grind true.
	Brushes too short.	Replace with harder grade—if worn too soon . . . and not by rough commutator.
	Shorted armature winding.	Test for short—after removing metallic contact between commutator bars. Repair.
2. Intermittent sparking at brushes.	Open armature winding.	Locate and replace bad coil—or repair defective joint.
3. Motor won't start.	Usually line trouble.	Correct. Check source of power supply.
	Load too heavy. See if motor runs without load.	Reduce load—or replace motor with unit of greater capacity.

SYMPTOMS YOU CAN *HEAR*

4. Excessive hum.	Uneven air gap. Measure with feelers.	Replace bearings—before introduction of scraping noise indicates rotor is rubbing.
	Unbalanced rotor. Check on parallel bars.	Balance with solder on band—or weight attached by cap screw and lock washer.
5. Regular clicking.	Matter in air gap.	Take out rotor; remove matter.
6. Rapid knocking	Misalignment.	Realign set until knocking disappears.
7. Brush "chatter."	Extreme vibration.	See item 10, below.

SYMPTOMS YOU CAN *FEEL*

8. Vibration.	Misalignment.	Realign set.
	Vibration in driven machine.	Eliminate source in machine, if possible. Or a flexible belt drive may be in order.
9. Motor overheating. (Check with thermometer—don't depend on hand).	Overload. Measure load; compare with nameplate rating.	Check for excessive friction in motor, drive or machine. Reduce load, or replace motor with greater capacity unit.
	Dirt in motor. Check flow of air.	Blow out motor. Use solvent on wound section if necessary.
	Rotor rubs stator.	Replace bearings.

A 1638

ALLIS-CHALMERS MOTORS

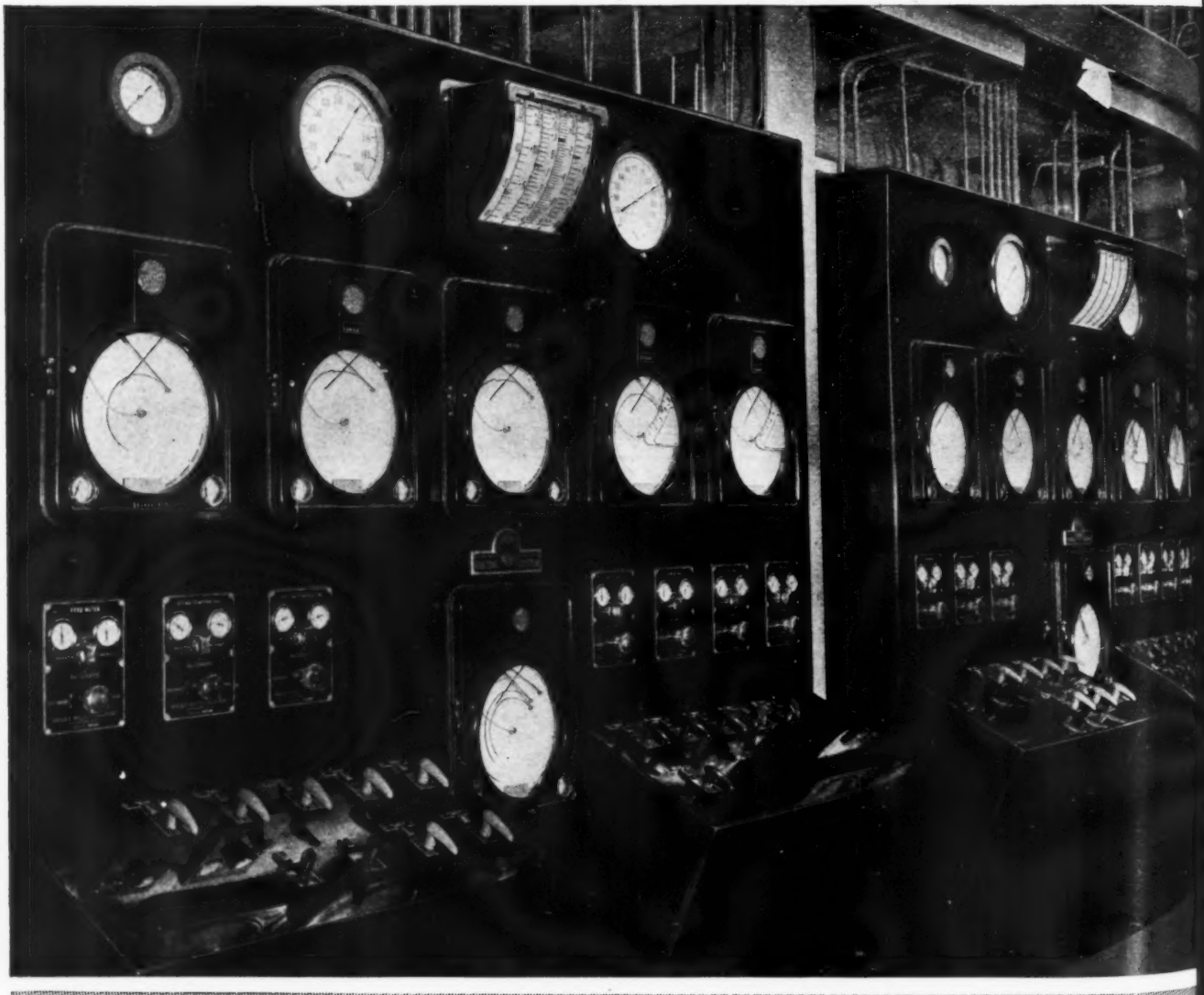
When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

A-C WE WORK FOR VICTORY WE PLAN FOR PEACE

MORE THAN

AND

Bailey Boiler Control Panels for two 135,000 lb. per hour capacity, oil and gas-fired boilers in a Western Power Station



BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

METERS

CONTROLLERS

A Bailey Boiler Control System is more than just a oup of meters and controllers recording and controlling rtain factors in the boiler plant. It is a means of im-oving plant operation from the standpoints of:—

Continuity of service **3. Steaming capacity** **5. Safety**
Fuel conservation **4. Conservation of manpower**

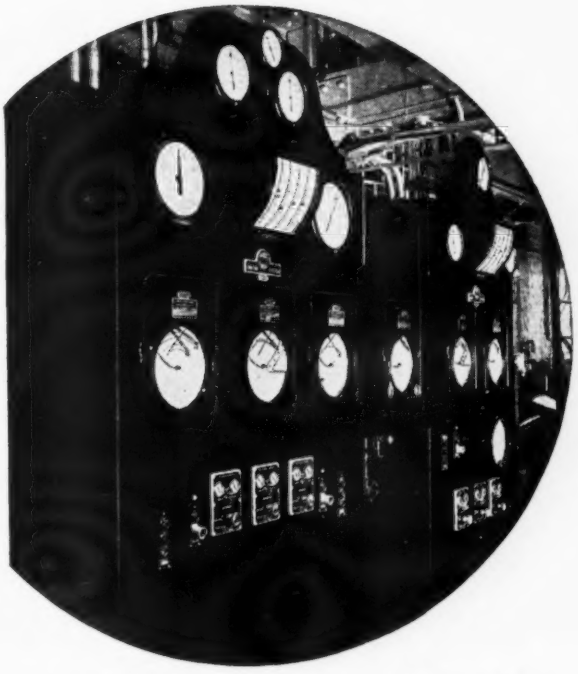
iley Control Systems are effective because each system carefully engineered to the requirements of the unit ich it serves. The experience gained from thousands successful combustion control installations serves as a sis for this engineering service which starts with the lection of equipment and continues through the de-gn, construction, calibration, installation and final justment on the job.

gineering work is done in the user's plant by Bailey ld Engineers who have been thoroughly trained in mbustion and automatic control practice. These engi-ers are stationed in over 30 industrial areas throughout e United States and Canada for the purpose of render-prompt "on the spot" engineering service without due traveling expense.

e Bailey engineer in your community has a wide back-ound of combustion engineering know-how at his mmand. It includes the records of tests on thousands boiler installations covering a wide range of fuels, naces and fuel-burning equipment. He has more to er than meters and controllers. He is primarily inter-ed in helping you to secure optimum operating nditions in your plant. G-19

AILEY METER COMPANY
6 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

Bailey Boiler Control Panel for 100,000 lb. per hour capacity Integral-Furnace Boiler

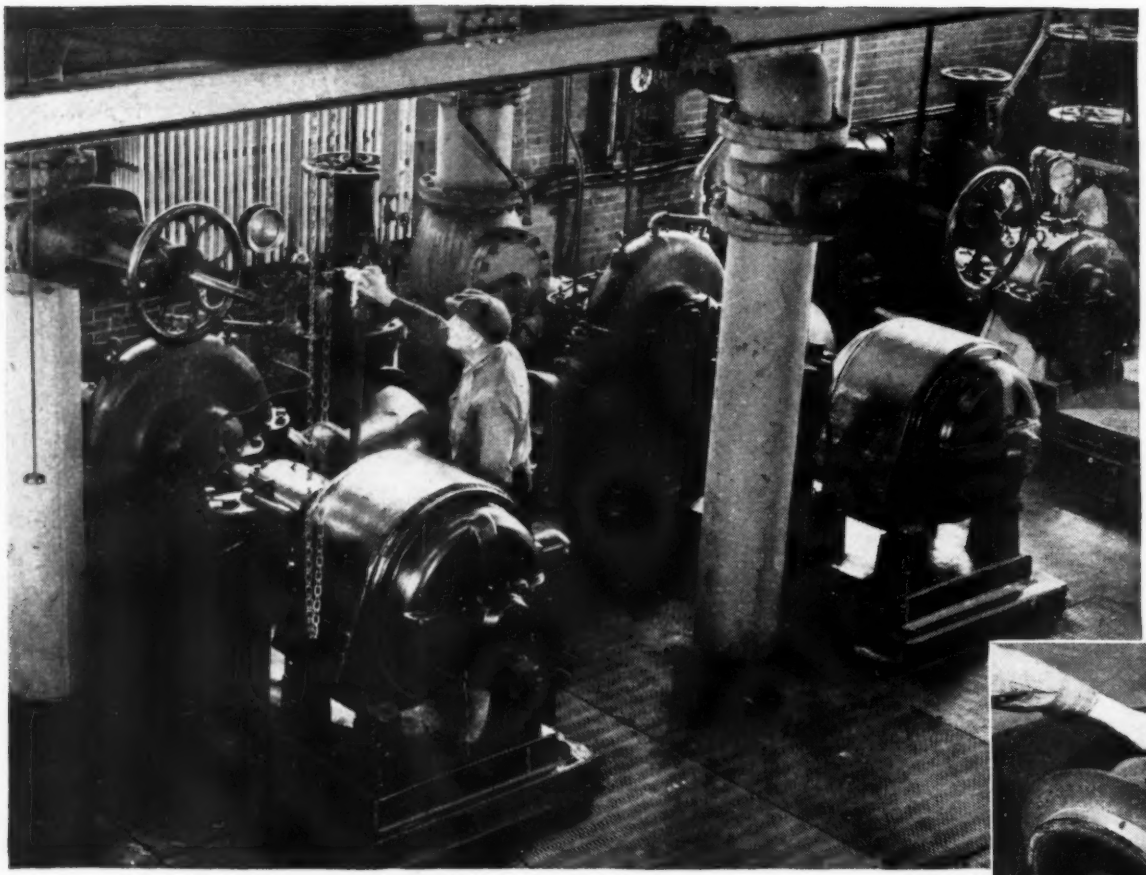


Bailey Boiler Control System in an Eastern Paper Mill

e Complete Combustion Control System

TROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

200% EXTRA IMPELLER LIFE TO DATE



USED IN PUMPS *that range in capacity from 3500 to 9500 gallons per minute, impellers of strong, tough, corrosion-resistant cast Monel outlast former impellers by more than 3 to 1. (The wearing sleeves on the pump shafts are cast "H" Monel and forged "K" Monel.)*

Hunt's Point Engineers use Monel to withstand highly corrosive action of sewage-laden sea water

Corrosion-*plus* was an operating headache at the Hunt's Point Plant of the Consolidated Edison Company.

The water for cooling the hot gas must come from New York's East River.

But into this drains one of the city's main sewage outlets, ten feet in diameter, constantly spewing out a flood of waste right beside the plant.

The circulating pumps must handle as much as 25,000 gallons of this polluted salt water a minute. At first, impellers never averaged more than 18 months of service.

Then, more than 6½ years ago, the first Monel impeller was installed.

Additional Monel impellers have been installed in three other circulating pumps at the Hunt's Point plant. The average life of all the Monel impellers is over 4½ years . . . 3 years more than the average working life of the former type.

* * *

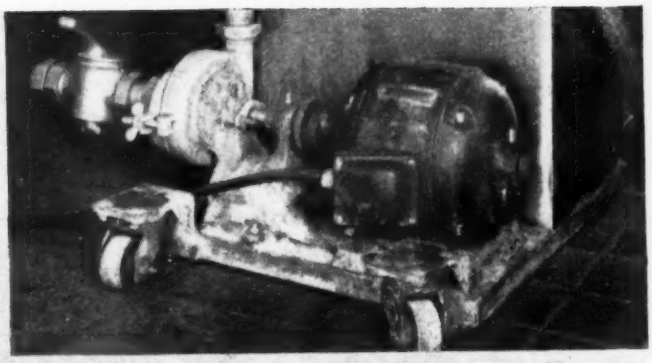
Monel is the logical metal for use in applications requiring *high resistance to erosion and corrosion.* In addition, Monel is *strong* and *tough* . . . plus properties that uniquely fit Monel for service where a combination of all three properties is essential.

Today, Monel is reserved for applications essential to war production. After the war, it will be again available for general use in long-lived, economical power plant equipment. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL
"KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
Sheet - Strip - Rod - Tubing - Wire - Castings

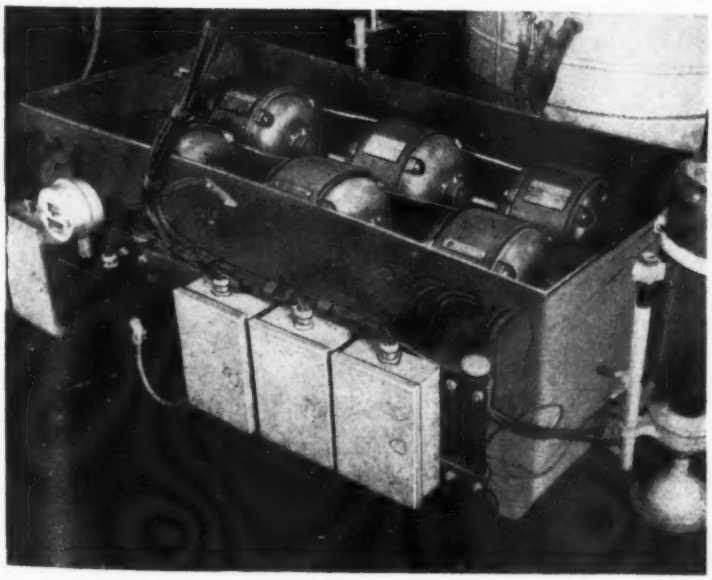
DOUSED DAILY!



G-E Tri-Clad motor coupled to a centrifugal pump on a portable cleaner in the milk plant of H. P. Hood & Sons, Inc., Charlestown, Mass.

POWERING A DAIRY PUMP, this Tri-Clad splashproof motor gets a dousing every day as the plant is hosed down. After years of service, frame and end shields are virtually uncorroded, insulation is going strong. G-E "protection tests", both in the development of the Tri-Clad design and in our daily production, help us assure you of long-lasting service from Tri-Clads on motor-wracking jobs like this.

"Hot Box" at 100% humidity tests TRI CLAD motor protection



Here is one of the many development tests which helped to prove the *extra* stamina engineered into the Tri-Clad design. In the bottom of this moisture box, just below the motor base, two inches of water was maintained at 212 F. The cover kept the humidity within the box at 100 per cent. By operating motors in this atmosphere to the breakdown point, G. E. got the low-down on the coil insulation's moisture resistance. Tri-Clad motors, in both open and splashproof construction, showed up unusually well in this extra-severe test. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI CLAD MOTORS

Every week more than 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

DO YOU KNO
Mobilo
REG. U.S. PAT. OFFICE
USAF 1241 F

THESE SIX ADVANTAGES OF THE

NO-BLO TUYERE?

A TUYERE, though small, is a mighty important part of a stoker. Things can happen to it which defeat the purpose of fuel firing equipment—the generation of steam—continuously and at low cost.

The tuyere now available on Taylor Stokers climaxes many years of development—and answers the requirements of cold or preheated air. Its use, under severe conditions, has shown an increase in efficiency, in life, and in fuel burning rate at the same time accompanied by a lowered maintenance rate.

These are 6 specific reasons for this:

1. Improved design of air channels and air discharge—more finely divided streams of air.
2. Locking lug removed from nose—fastening remains intact even if nose is burned away.
3. High ratio of cooling area to heat absorbing area—means a cooler tuyere and longer life.
4. Less horizontal area per tuyere—smaller steps—less resistance to movement of fuel bed.
5. Fewer burnouts and longer life because of unique undercut fin construction. In the No-Blo design the fins terminate before reaching the edge of the tuyere toe, forming a peripheral air channel when slag blocks the air vents. Thus continuous proper air flow and air cooling is assured.
6. Greater coal burning capacity—less replacement expense.

Yes, the No-Blo Tuyere is just one of the features responsible for the efficient, reliable operation of the Taylor Stoker in generating steam at low cost. But it is an important one.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. RELIABILITY—the ability to operate with minimum outage and minimum standby equipment.

2. CAPACITY—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. MAINTENANCE—the ability to operate continuously with minimum repair costs.

4. FLEXIBILITY—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. EFFICIENCY—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

6. OPERATION—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. ADAPTABILITY—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.

8. FUEL FLEXIBILITY—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. REFUSE DISPOSAL—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

10. STACK DISCHARGE—the practical elimination of "smoke nuisance" without special equipment.

11. SPACE REQUIREMENTS—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

12. OBSOLESCENCE—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

AMERICAN ENGINEERING COMPANY

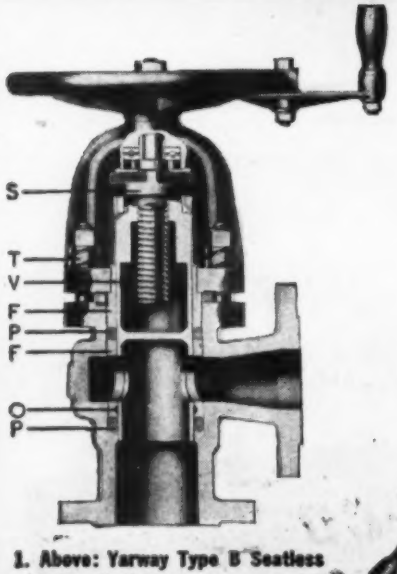
PHILADELPHIA 25 • PENNSYLVANIA

BLOW-OFF

At left, Yarway Seatless and Double-Tightening Valves in Tandem, for pressures up to 250 lb

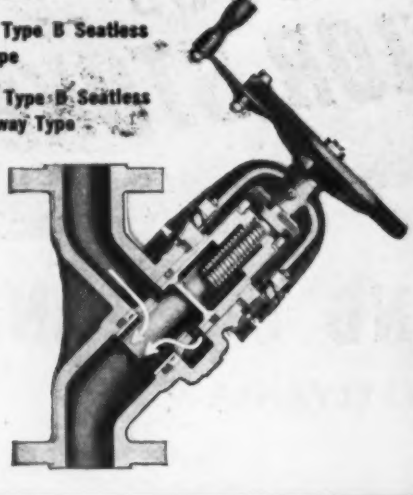
At right, Yarway Seatless Tandem for pressures up to 400 lb

FOR EVERY



1. Above: Yarway Type B Seatless Valve, Angle Type

2. Below: Yarway Type B Seatless Valve, Straightway Type



Yarway offers a complete Blow-Off Valve Service—FOUR DISTINCT TYPES OF VALVES to answer the Blow-Down Requirements of every steam plant.

Each is the product of more than a quarter-century of mechanical and metallurgical research—of practical field experience with more than 12,000 installations—of a determination continually to lead the Industry with the finest blow-down equipment that can be produced.

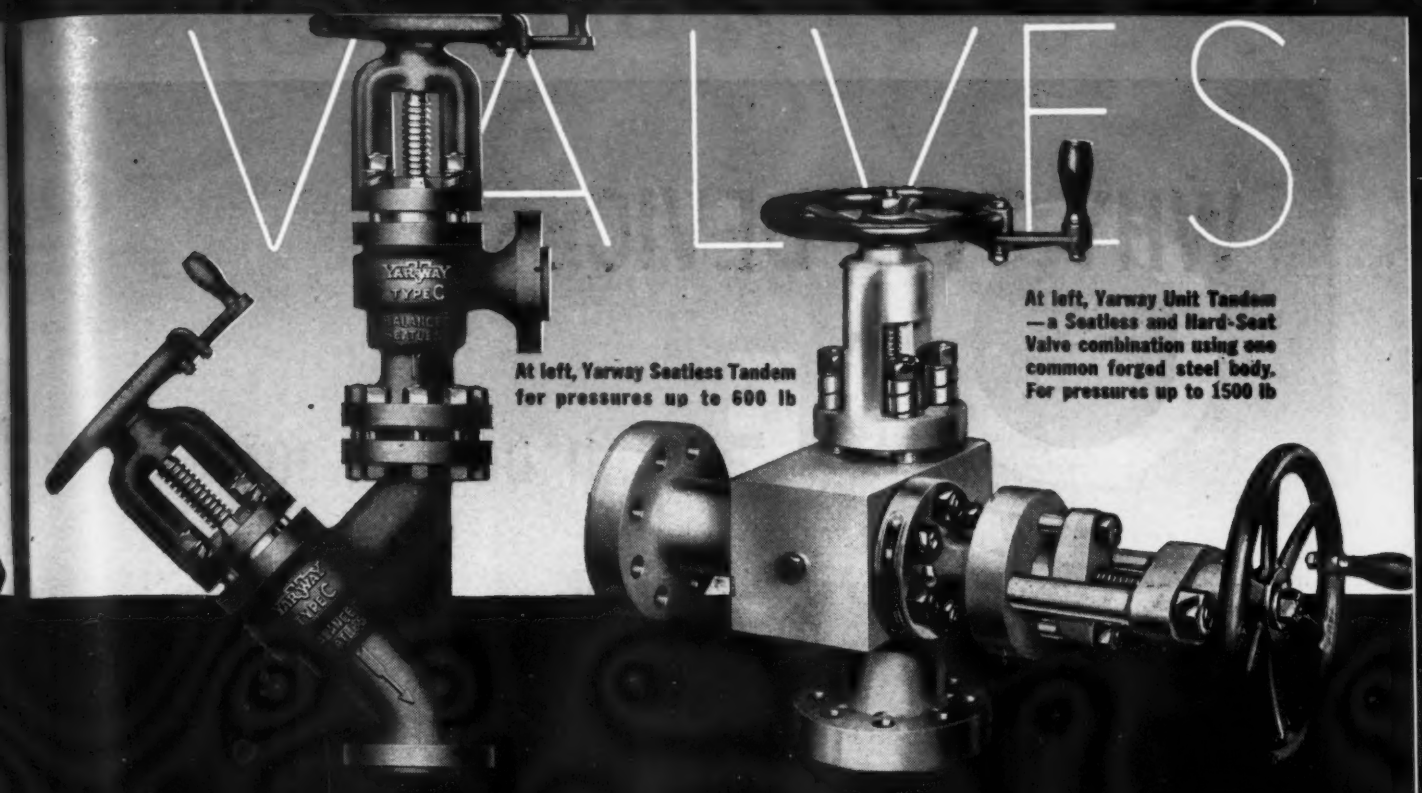
Because the Yarway line is complete you may be sure Yarway recommendations will be unbiased, based on honest judgment that the type valve selected will give long, trouble-free, money-saving service on the job.

Write for catalog; For pressures up to 400 lb, Section 422; For higher pressures, Section 431.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY

VALVES



At left, Yarway Seatless Tandem for pressures up to 600 lb

At left, Yarway Unit Tandem —a Seatless and Hard-Seat Valve combination using one common forged steel body. For pressures up to 1500 lb

PRESSURE

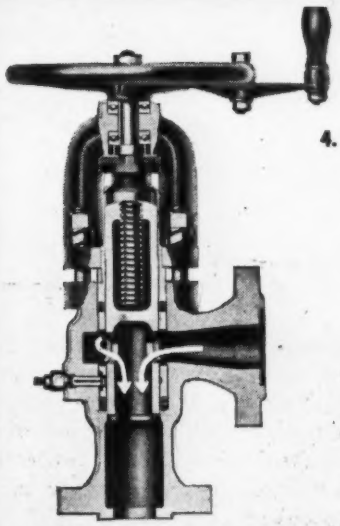
Yarway Type B Seatless Valves are of balanced, sliding plunger design. Made in Angle (Fig. 1) and Straightway (Fig. 2) Types. Operation of Yarway Seatless Valves: After valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packings P, above and below port, making an absolutely tight valve. Yoke springs T maintain continuous pressure through follower glands F, on packing rings P. Annular groove O connects with alemite fitting for lubricating plunger and packing; alemite lubrication also provided for stem.

•

Yarway Type C Seatless Valves (Fig. 3) are made in both angle and straightway types. In this design the longer plunger protects the packing from blow-down at all times. Other features are laminated packing with stainless steel inserts, nitralloy plungers, alemite lubrication, ball thrust bearings.

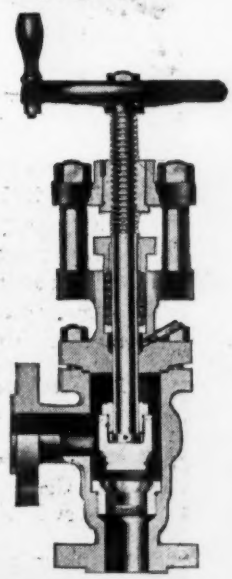
•

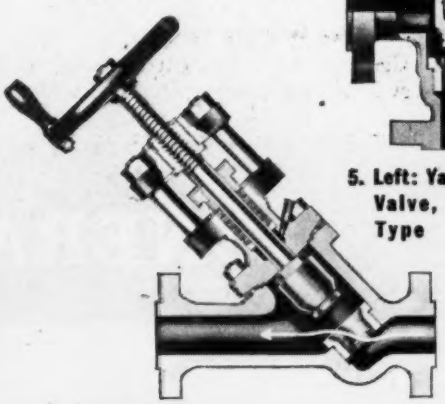
Yarway Hard-Seat Blow-Off Valves are of cone seat and disc type, having metal-to-metal contact. These valves are made in angle type (Fig. 4) and straightway easy flow type (Fig. 5). Features of the Yarway Hard-Seat Valve include: Marine and cast steel type yoke with threaded bushing, packing gland with bronze liner, large packing space, long-shank stem. Disc and seat ring are stainless steel; beveled faces have stellite inserts which provide smooth, hard-wearing surfaces at this important point.



3. Above: Yarway Type C Seatless Valve, Angle Type

4. Below: Yarway Hard-Seat Valve, Angle Type



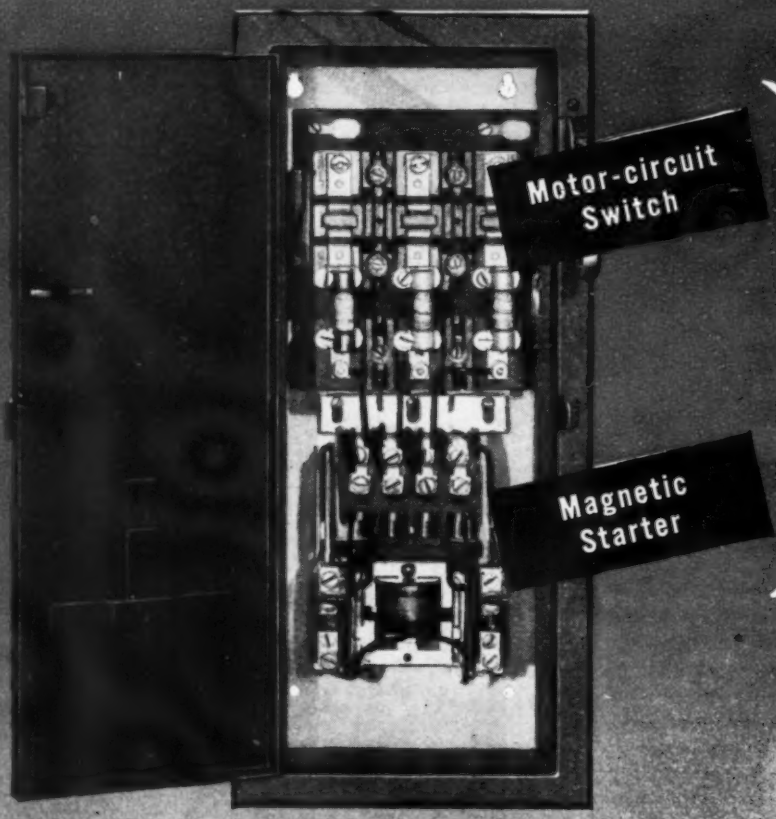


5. Left: Yarway Hard-Seat Valve, Straightway Type

BLOW-OFF VALVES

WHY TWO DEVICES?

ONE CAN DO THE JOB



COMBINATION STARTER

Gone are the days when you had to buy a separate device for each function of motor control. Now, whatever your plant's operating conditions, you can get *combination* control. This means a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one, compact, easy-to-mount unit. Look:

50% reduction in mounting time
Mount only one device, not two.

40% reduction in wiring time
Connect to only 9 terminals, not 15. The switch and starter come already connected.

Increased safety
Cover cannot be opened while there is power on the starter.

Reliable motor protection
Protection devices co-ordinated in starter at the factory.

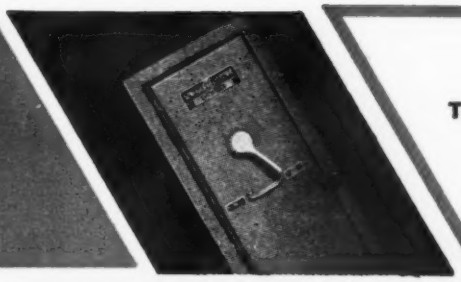
Saving of wall space
The one device takes less space than two.

Improved plant appearance
Single, streamlined case — less open wiring and conduit.

Look over the selection on the next page—and then mail the coupon for more information about the G-E combination starter best suited for your job.

GENERAL ELECTRIC

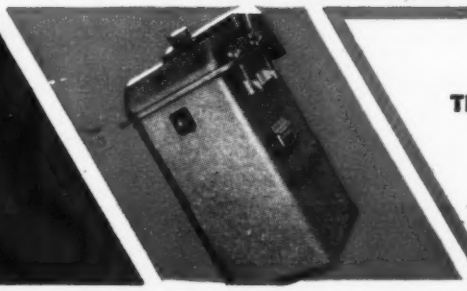
GENERAL PURPOSE



THE TYPE 1 ENCLOSURE is suitable for general-purpose, indoor applications where atmospheric conditions are normal. Available up to and including NEMA size 5.

INFORMATION IN BULLETIN GEA-3715

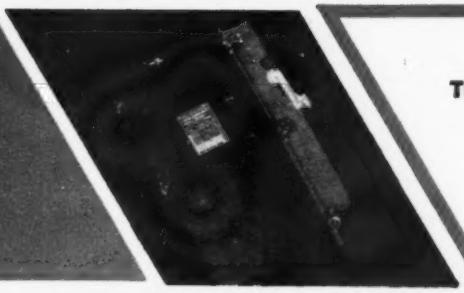
ORROSION-
ESISTANT



THESE STARTERS are made in two forms—one for corrosive atmospheres (Type 3) and one for hazardous locations (Type 8). All arcing parts and terminals (of forms for hazardous locations) are at least six inches under oil.

INFORMATION IN BULLETIN GEA-3541

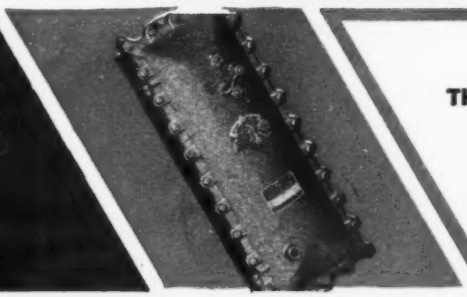
DUST-
TIGHT



THE TYPE 5 ENCLOSURE is for use in steel mills, cement mills, and other locations where the dust content of the atmosphere is so heavy as to make a dust-tight case desirable. The cases are heavy sheet metal, equipped with heavy gaskets, clamping bolts, and wing nuts.

INFORMATION IN BULLETIN GEA-3715

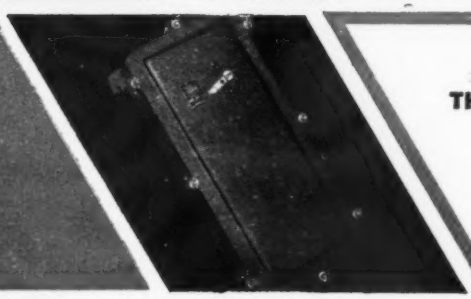
R HAZARDOUS
LOCATIONS



THE TYPE 7 CASE for Class I, Group D, locations is made of cast, high-strength alloy. These starters are designed to withstand internal explosions. The flanges, which are securely bolted on all sides, are grounded to tolerances that will not permit the escape of hot gases.

INFORMATION IN BULLETIN GEA-3804

WATERTIGHT



THE TYPE 4 CASE is suitable for outdoor use, and for damp places indoors, such as dairies, breweries, and ship docks. The cases are of cast iron, or fabricated boiler plate, with a special weatherproof finish and corrosion-proof fittings.

INFORMATION IN BULLETIN GEA-3715

NEW HIGH-VOLTAGE COMBINATION

This recently developed combination starter provides split-cycle protection and starting means for 2300- and 4000-volt motors.

INFORMATION IN BULLETIN GEA-3660

BUY WAR BONDS

Which of these bulletins may we send you?

General Electric Company, Section H676-95
Schenectady, N. Y.

Please send me the publications checked below.

- ☐ GEA-3715 — General purpose, dust-tight, watertight
- ☐ GEA-3804—For hazardous locations
- ☐ GEA-3541 — Corrosion-resistant
- ☐ GEA-3660—For high-voltage service

Name.....

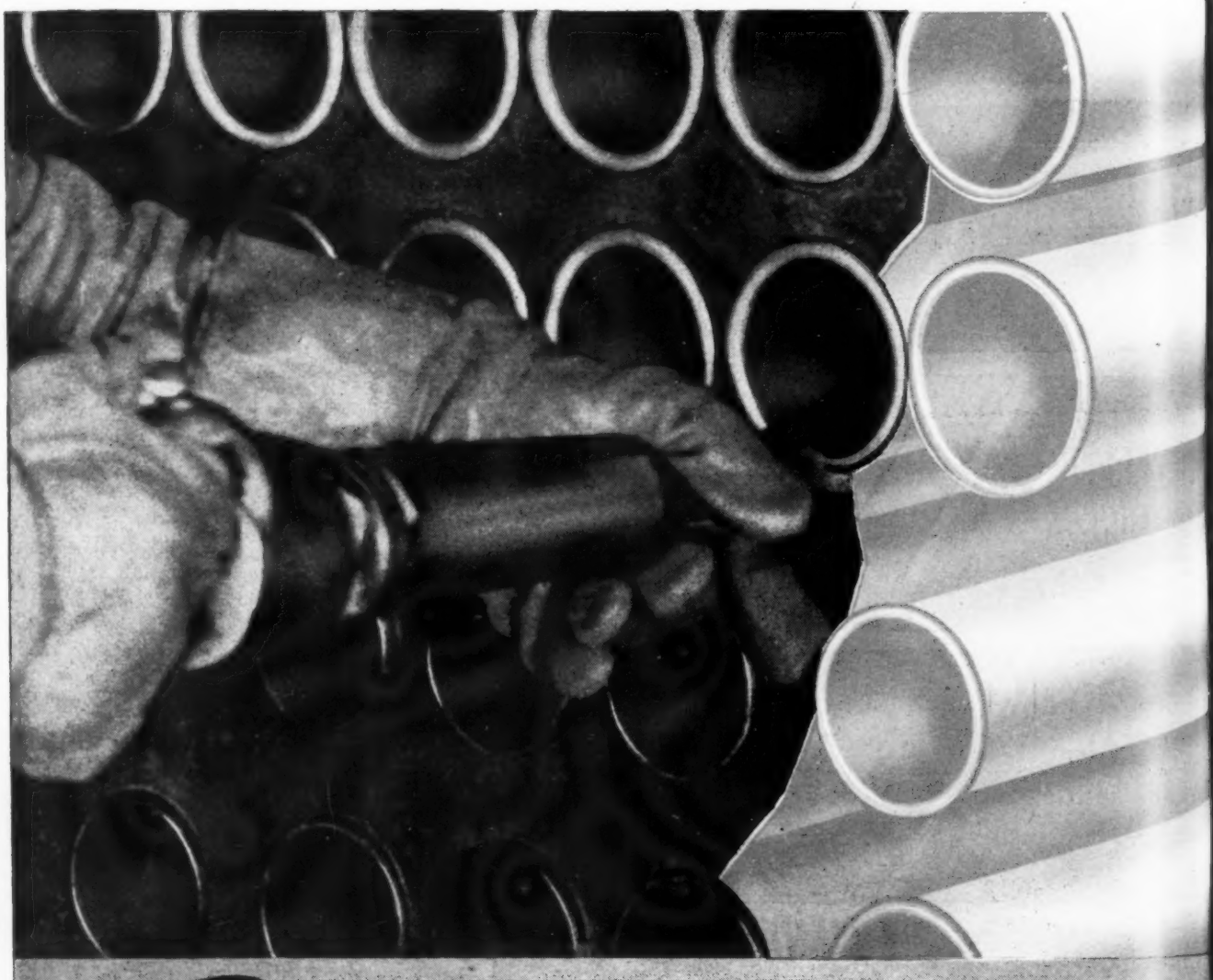
Company .....

Address.....

City..... State.....

NO NEED TO ANNEAL

—EVERY ELECTRUNITE BOILER TUBE



Republic

ELECTRUNITE

REG. U. S. PAT. OFF.

TUBE ENDS ON THE JOB

IS FULL NORMALIZED THROUGHOUT

Republic ELECTRUNITE Boiler Tubes are all ready for expanding, rolling in and beading—easily and rapidly—when you receive them.

Even when you must cut tubes into short lengths, *the cut ends roller expand and bead just as easily* to tight, non-weeping joints.

It never is necessary to further anneal ELECTRUNITE Tube ends—because these tubes are *full normalized throughout.*

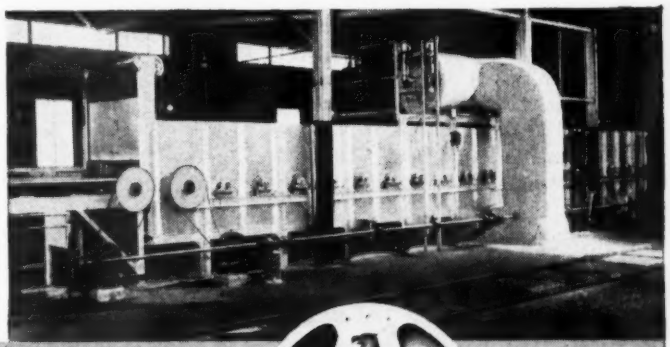
All cold working stresses in the metal are relieved. Ductility, toughness and fine grain size are uniform—throughout every tube, and every shipment of tubes. There are no hard spots to cause rolling difficulties.

ELECTRUNITE Tubes are normalized in a controlled-atmosphere furnace—without formation of corrosion-inviting scale. Since there is no need for further annealing on the job, the smooth tube surface is undisturbed—and tube life is extended.

Full normalizing is only one of the advantages of ELECTRUNITE Tubes. In addition to the uniform ductility and fine surface thus obtained, they are consistently uniform in diameter, wall thickness and concentricity. They slide through tube sheet holes freely, and expand evenly all around. They cut installation, repair and boiler outage time. Users report up to 30% savings in installation costs.

Republic ELECTRUNITE Tubes meet all standard specifications, including those of the U. S. Navy and Federal Government. Their record of safety and economy covers more than 10 years of service in all types of boilers. Write for further information.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
Sales Offices • Cleveland 8, Ohio
GENERAL OFFICES • • CLEVELAND 1, OHIO
Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Union Drawn Steel Division
Truscon Steel Company
Export Department: Chrysler Building, New York 17, New York



ELECTRUNITE Tubes are full normalized—without scale formation—in a continuous controlled-atmosphere furnace—then given a thin blue ozide coating as they pass through a second furnace.

REPUBLIC STEEL CORPORATION, STEEL AND TUBES DIVISION, IS THE ONLY PRODUCER OF ELECTRUNITE TUBING

REPUBLIC STEEL PRODUCTION FOR VICTORY

BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 2

"Phosphorized Admiralty"—and its dezincification-resistance

The qualities of this condenser tube material as confirmed in actual performance and reported by Scovill engineers

Millions of pounds of Phosphorized Admiralty are now in use in heat exchanger and condenser service — some since 1939 when this Scovill material was first introduced. Phosphorized Admiralty has built up a remarkable performance record and its resistance to dezincification is of a high order.

An explanation of this may be of interest.

The *dezincification-resistance* of Phosphorous bearing brasses is well known.

The *marked influence* of a very small percentage of Phosphorous in controlling this form of corrosion of Brass has been the subject of considerable research. In this connection, much interest has been shown not only in the actual ability of Phosphorized Admiralty and other phosphorized brasses to inhibit dezincification but in the reasons for the beneficial effect imparted to such alloys by Phosphorous.

Several theories have been advanced and much investigational work has been carried out to explain the inhibiting action of Phosphorous in brasses under service conditions which would normally result in dezincification of the metal. This problem will be better understood by a consideration of the properties of Phosphorous and its compounds.

Phosphorous is non-metallic in character and enters into combination with Oxygen to form a series of oxides. From Phosphorous and its various oxides, a number of metal salts may be obtained. With the exception of Sodium and Potassium salts, these metal compounds are, in general, insoluble in water. In some cases, these salts exhibit colloidal properties to some degree. The end product of the oxidation of Phosphorous gives ortho-phosphates and, in the presence of sufficient Oxygen, ortho-phosphates will be found.

One interesting detail in connection with the compounds of Phosphorous is the behavior of Tin and Phosphorous when they are present in the same solution. Tin Oxide in colloidal solution readily takes up or absorbs Phosphates and this reaction usually hastens the precipitation of Tin in a very insoluble form. It was earlier believed that this reaction was entirely of a colloidal nature, but, recently, it has been shown that a definite compound of Tin Phosphate is formed, at least in certain conditions. This particular reaction between Tin and Phosphorous compounds is stressed because it has been noted in a research on the dezincification of brasses that the presence of Tin in itself retards dezincification to some extent; but the addition of Phosphorous (as in Phosphorized Admiralty metal) is necessary to prevent dezincification of the alloy.

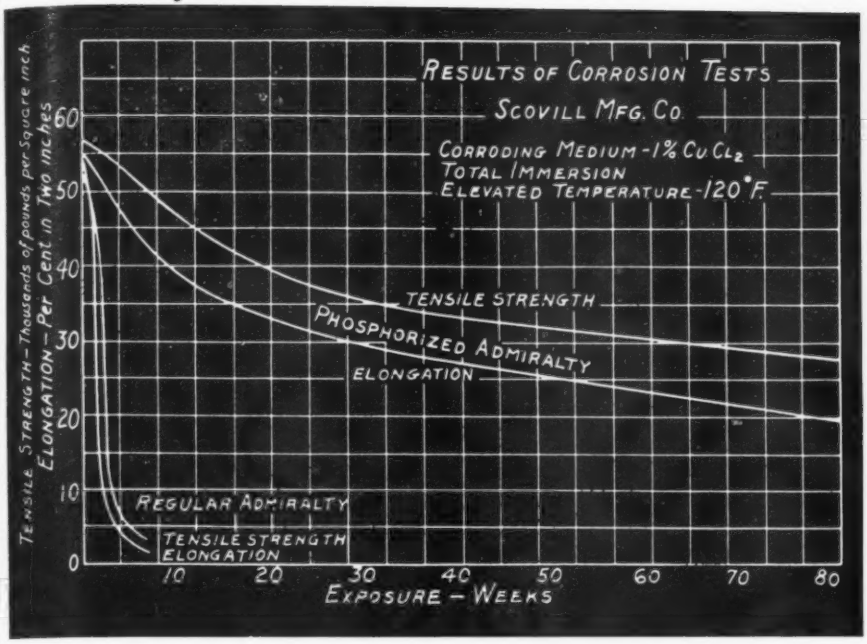
If the foregoing discussion of the formation of insoluble and colloidal metal salts of Phosphorous is remembered, the dezincification-resistant property imparted to Brass by the addition of Phosphorous can more readily be explained. In services where dezincification of Admiralty metal or other brasses has been experienced, the phosphorous content of the dezincification-resistant alloys probably promotes the formation of a protective film (in the nature of a metal phosphate or phosphide such as Copper Phosphide Cu_3P_2), which coats the metal surface at initially corroded areas and arrests further action at such areas.

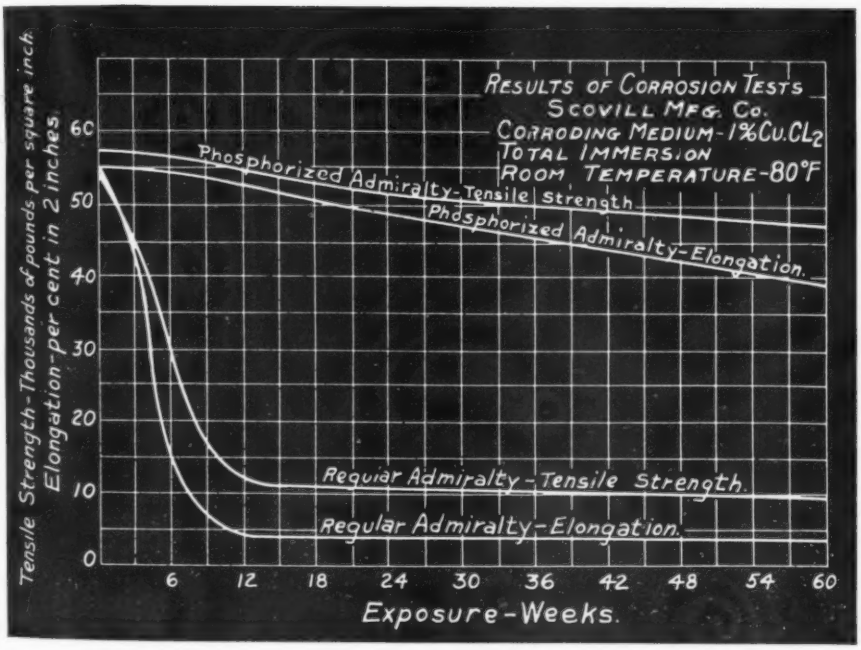
The reactions which take place in the formation of the phosphorous containing film may or may not be complex in nature, as may be anticipated from the above remarks on the chemical reactions of Phosphorous. Thus, in the early stages of corrosion, Phosphorous, together with Copper, Zinc and Tin may pass into solution and the Phosphorous may then combine with certain of the metal ions in solution to form an insoluble compound which coats the metal surface as a stable impervious film. The formation of this compound may involve nothing more than introduction of ions of the reacting elements into the solution, followed by precipitation and deposition of certain combinations of such ions on the metal surface.

It is probable, however, that a more complex series of reactions takes place and may be better explained by considering the existence of colloids in the medium in contact with the metal surface. In this connection, it may be pointed out that very minute quantities of colloids in a solution often times produce a profound change in the behavior of such solutions. In the plating of metals, for example, colloids in the plating bath may alter the type of plate, may prevent plating altogether, or may change the conditions (current density, voltage, etc.) at which satisfactory plating may be carried out. The subject of plating is introduced in this discussion of colloids because dezincification may be looked upon as a plating operation in which Copper is plated upon the brass, usually in the form of a porous, brittle mass. In the case of Phosphorized Admiralty tubes, colloidal Tin Phosphate or other metal phosphates may play an important part in preventing dezincification of the alloy.

This discussion of the part which Phosphorous plays in preventing dezincification of Admiralty metal and other Brasses has necessarily been brief and has been presented only because of the interest which has been shown in this subject.

Wherever dezincification of Admiralty metal tubes has been a serious corrosion problem, the use of Phosphorized Admiralty metal tubes is suggested. This alloy combines the general excellent corrosion-resistant properties of Admiralty metal, a desirable fine grain structure of




RESULTS OF CORROSION TESTS
SCOVILL MFG. CO.
CORRODING MEDIUM - 1% Cu.Cl_2
TOTAL IMMERSION
ROOM TEMPERATURE - 80°F
Phosphorized Admiralty - Tensile Strength
Phosphorized Admiralty - Elongation
Regular Admiralty - Tensile Strength
Regular Admiralty - Elongation
Tensile Strength - Thousands of pounds per square inch
Elongation - per cent in 2 inches
Exposure - Weeks.

developed primarily for oil refineries and gasoline plants because in those places the phenomenon of dezincification is pronounced and widespread, it is equally applicable to any situation where dezincification of Admiralty is a problem — particularly at elevated temperatures.

"Phosphorized Admiralty tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by the owner of this Scovill Manufacturing Company patent, or one of its licensees.

Scovill Offers 3 Services to Tube Users

1. Information, like that appearing on these pages, which will help keep engineers informed of recent developments and recent thinking in the matter of condenser tubes. The new "Condenser Tube Booklet" — a part of Scovill's *Service in Manuals* is available, free, from Scovill Manufacturing Company, 13 Mill Street, Waterbury-91, Connecticut.

2. Research in Metals is another Scovill service, intended to establish new knowledge about metal alloys which will help develop better performance on the part of Scovill condenser tubes. Scovill *Service in Metals* also includes the testing of raw materials, the testing of finished tubes before shipment and the analysis of problems arising from tubes in service.

3. Individual recommendations for each customer's requirements constitute the third Scovill service. *Service in Men* brings you a wealth of experience to help you obtain the best results and to eliminate trouble causes.

the finished tubes, favorable physical properties and a very definite improvement over Admiralty metal in its very marked resistance to dezincification.

While Phosphorized Admiralty was

Limitation order L-154 issued by the OPM, limits the use of nonferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No nonferrous metals containing more copper and more tin than these two are permitted by the order.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

Seven-year Burial proves superiority of FLAMENOL INSULATED CABLE

After seven years in series-lighting service, buried directly in the ground, this two-conductor, concentric No. 8 Flamenol cable is still as good as new.

FLAMENOL'S LASTING PROPERTIES GIVE LONG, ECONOMICAL SERVICE UNDER SEVERE OPERATING CONDITIONS

More than six years before Pearl Harbor, an Eastern power company made a direct-burial installation of Flamenol cable. After seven years' service, part of it was removed and the insulation was tested—with these results:

Physical Condition: *Excellent*

Insulation Resistance: *336 megohms per 1000 ft*

Tensile Strength: *2560 lb per sq in.*

Elongation: *220 per cent*

Many thousands of feet of Flamenol have since been installed underground for series lighting and 600-volt power circuits. Tests after varied lengths of service show that physical and electrical characteristics of the insulation remain practically unchanged.

Specially developed for severe operating conditions

Years before any rubber shortage, G-E engineers turned to synthetic resins for improved cable insulation. Flamenol, the first such cable to be utilized commercially, proved vastly superior to rubber-insulated cable for service under adverse conditions.

Today, after years of constant development, Flamenol cable offers a wide range of operating advantages:

FLAME RESISTANCE

Does not support combustion.

CORROSION RESISTANCE

Immune to action of oils, acids, alkalies.

AGING

Does not oxidize. Highly resistant to sunlight and weathering.

PHYSICAL PROPERTIES

Tensile strength, 1500 lb per sq in., minimum. Elongation, 100 per cent, minimum.

DIELECTRIC STRENGTH

720 volts per mil, retained through severe operating conditions.

In addition to these *time-proved* operating advantages, Flamenol cable is easy and economical to install and maintain. That's why millions of feet of this long-lived cable are used for power and lighting circuits in the chemical, food, textile, printing, oil, mining, steel, automotive, railroad, and other industries. For detailed information on uses, constructions, sizes, etc., write for Leaflet GEA-2733D. *General Electric Company, Schenectady, N. Y.*

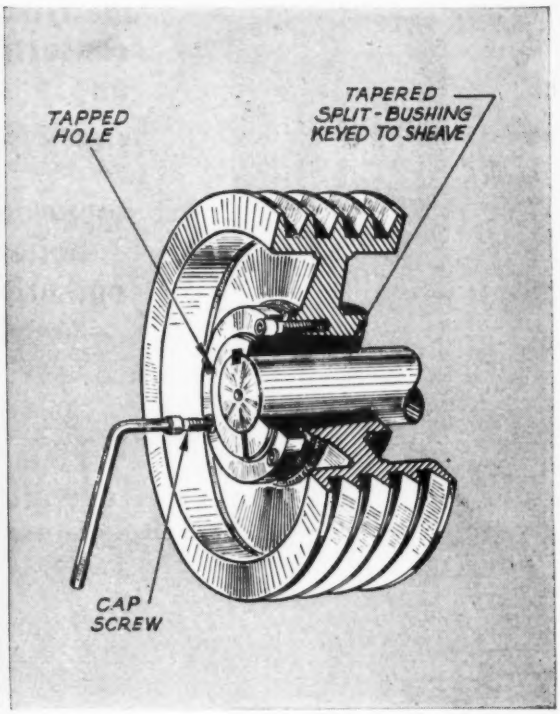
7 Extras That Insure EASY INSTALLATION, ECONOMICAL MAINTENANCE

1. SMALL DIAMETER saves space, facilitates wiring.
2. SMOOTH SURFACE assures easy pulling.
3. FREE STRIPPING speeds splicing, avoids nicking conductors.
4. DIFFERENT COLORS simplify circuit tracing.
5. VARIOUS CONSTRUCTIONS to suit special applications.
6. SELF-PROTECTING finish eliminates need for conduit.
7. RETAINS ATTRACTIVENESS makes re-painting unnecessary.

GENERAL ELECTRIC

Allis-Chalmers announces a new Sheave that "Grips like Magic!"

Three cap screws, 1 small wrench, are all it takes to lock "Magic-Grip" sheave uniformly on shaft . . . creating a positive clamp fit.



We call it "Magic-Grip" because in just one quick operation sheave locks securely to shaft, saving man-hours and downtime!

DESIGNED for ease and speed in mounting and removing, Allis-Chalmers' great new "Magic-Grip" is the fastest mounting sheave on the market. Its tapered split bushing locks sheave to shaft in a single operation . . . *without forcing.*

"Magic-Grip" assures smooth running action, too. Its new design permits sheave to be mounted close to motor — reducing shaft overhang, increasing bearing life.

And you get these extra advantages *at no increase in price.* Now, more than ever, it pays to make Allis-Chalmers your "V-Belt Headquarters."

Sheaves that "grip like magic" are stocked in a complete line in all major cities. Ask our district office or dealer for bulletin B6310. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1680

Allis-Chalmers Texrope "MAGIC-GRIP" SHEAVES

You can have
in the vital job
Reliance EYE-H
fills the gap betwee
worrysome uncertaint
and safe efficient con
Specified by consulting engineers
Approved by boiler authorities
Preferred by boiler operators
Reliance
EYE-HYE
Proved dependable in over 4000 installations
Reliance
EYE-HYE
1884-1944
Reliance

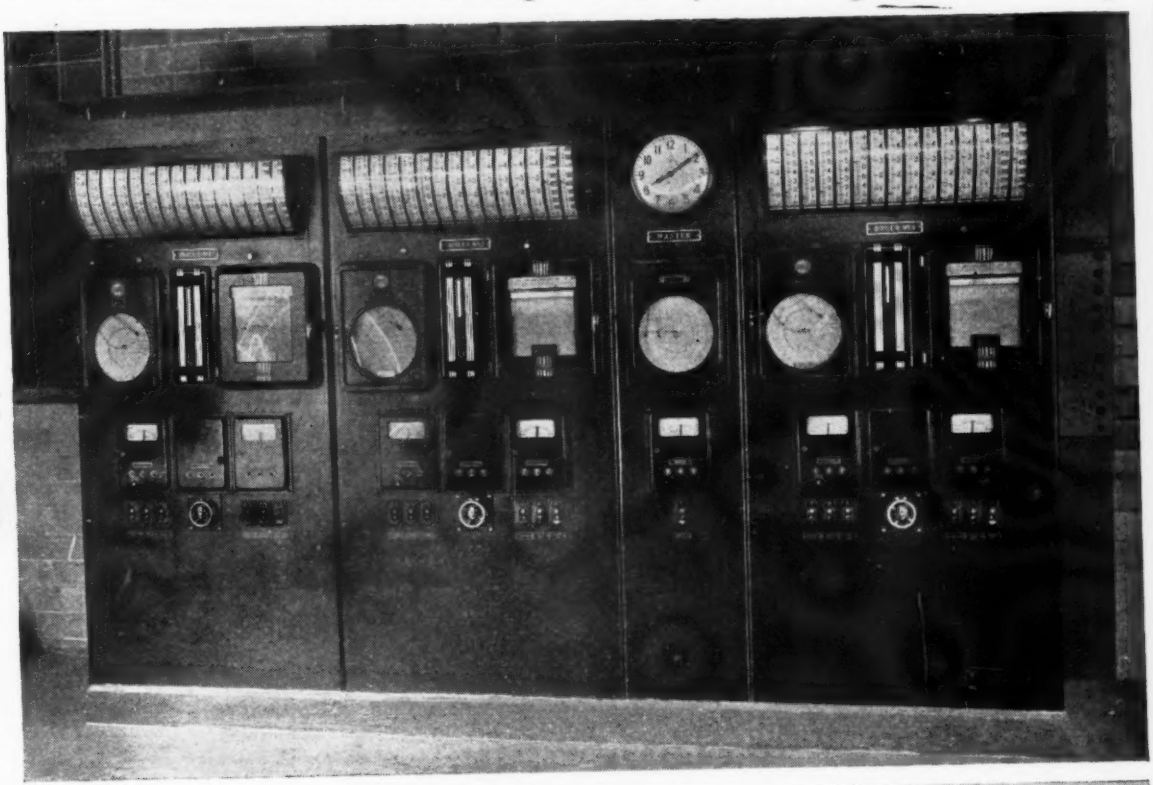
Compromise

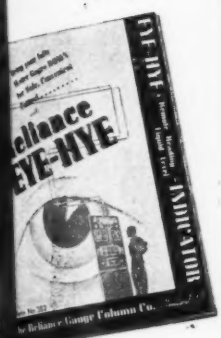
Boiler Water Level Supervision

● The convenience of reading your water levels in the EYE-HYE Remote Reading Indicator works wonders in boiler operating efficiency. There just isn't any excuse for not seeing whether all feed water controls are doing their part when EYE-HYE stares operators in the face alongside instruments and meters.

EYE-HYE isn't a post-war dream. It's here now, helping the men in charge of thousands of boilers to do a grand job of water level supervision. Our present output is "spoken for", but when Uncle Sam can slow down building ships there will be EYE-HYEs for your new power plant or for the face-lifting you plan for one that still has a lot of life ahead of it. Better W. L. S. makes boilers last a lot longer, too.

If you plan a new panel control board, an EYE-HYE for each boiler matches perfectly with other standard instruments. But whether panel-mounted or elsewhere, EYE-HYE's A-B-C simplicity brings you guaranteed accuracy of boiler water level indication. It's positive and dependable. A brilliant illuminated green indicator you see at a glance.





ahead—investigate the possibilities of easing the safety efficiency of your er level supervision EYE-HYE. Write Bulletin 382-C.

BOILER SAFETY DEVICES

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

THE RELIANCE GAUGE COLUMN CO.
Cleveland, Ohio

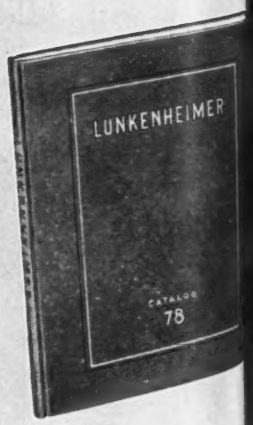
LENDING A HAND *to the* MAINTENANCE MAN

He can use plenty of help these days . . . his job of keeping the machinery of production going takes all he can give it. And among his most vital needs are valves that won't take a lot of costly time out for repairs . . . valves that he can depend upon for uninterrupted performance.

Such a valve is the Lunkenheimer "King-clip." Simple in design, exceptionally sturdy in construction, the "King-clip" is at its best when the going is tough. Also, it's a valve that lends itself to easy maintenance.

Note the illustration. See how easily the "King-clip" can be taken apart . . . how it simplifies maintenance. And when repairs are necessary, you can be certain that any replacement part will fit accurately—Lunkenheimer precision-gauged manufacture gives you that assurance.

Let your Lunkenheimer distributor help you with your maintenance, repair and operating problems. His facilities and experience are at your call.



Circular No. 504 is ful descriptive of the "Kin clip" Valve. Get a co from your Lunkenheim distributor or write us d rect.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.;
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

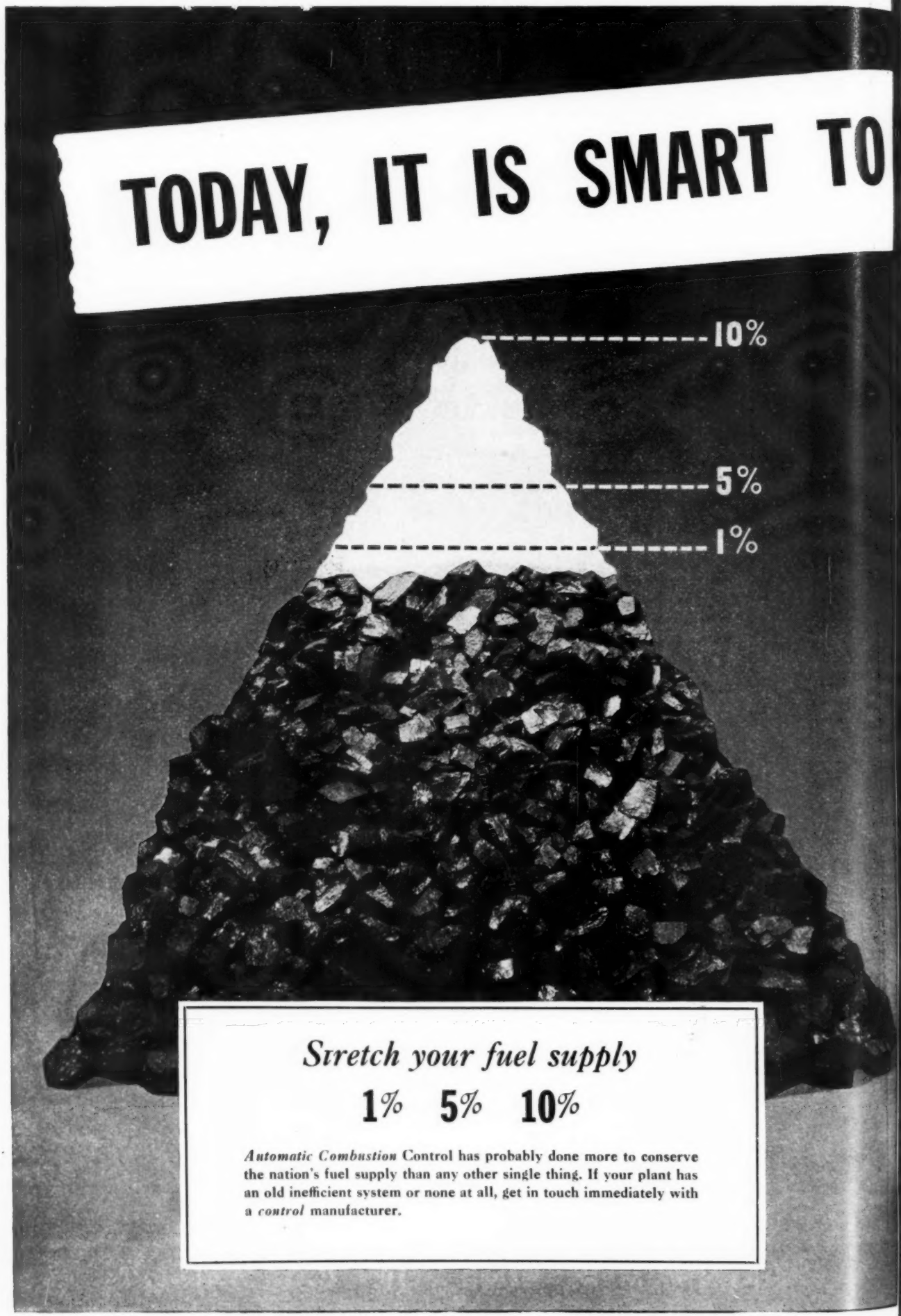
SIMPLICITY OF DESIGN—MEANS EASIER MAINTENANCE

YOU CAN TAKE IT APART IN A JIFFY . . . . . .

Simply unscrew two nuts at top of clip and entire bonnet-stem-disc assembly can be lifted from the body with complete accessibility for inspection or repairs.

LUNKENHEIMER "KING-CLIP" GATE VALVE

No. 5-87-49


TODAY, IT IS SMART TO
10%
5%
1%
Stretch your fuel supply
1% 5% 10%
Automatic Combustion Control has probably done more to conserve the nation's fuel supply than any other single thing. If your plant has an old inefficient system or none at all, get in touch immediately with a control manufacturer.

BE A "COAL-MISER"

— especially when you can improve overall operating efficiency at the same time!

ENGINEERS in hundreds of America's leading power plants are thankful that they had the foresight to equip their boilers with Hagan Automatic Combustion Control.

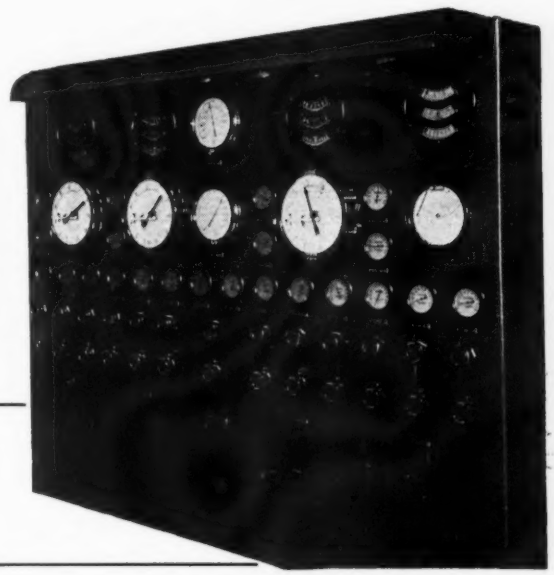
Today, coal has suddenly become a scarce commodity. Stretching what you have from 1 to 10 per cent through better combustion efficiency takes on special importance.

You *can* get such results, even though your firing equipment is *good*. Under less favorable conditions, a greater saving is not uncommon.

Reduced fuel consumption is just *one* of the many advantages offered by Hagan Control. Sound engineering and rugged construction make Hagan Control fast, accurate and dependable. How dependable is strikingly illustrated in a story just released by the War Shipping Administration.

An Africa-bound freighter had a 20 by 30-foot hole torn in her side by a torpedo. She was making tons of water, heeling over and settling down 12 feet by the head when the captain gave the "abandon ship" order . . . but that ship didn't sink! When engine department volunteers returned aboard they found that the plant was still seaworthy. The Hagan Automatic Combustion Control was still on and maintaining steam at the same pressure as before the "abandon ship" order was given. The freighter zigzagged to safety and continued on to port, 850 miles away!

Just those two factors — reduced fuel consumption—absolute dependability—are in themselves enough to warrant full inquiry. Shall we give you further information?



HAGAN
HALL
BUROMIN
CALGON

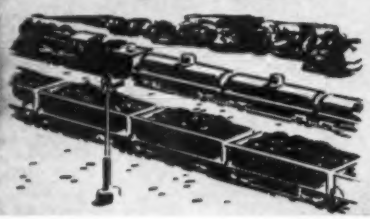
6.7% Coal Reduction per K.w.h. by this installation of Hagan Automatic Combustion Control in a medium-sized power plant.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

First Aid Chart

	WAR CONDITIONS	POWER PROBLEMS
Manpower	Skilled operators being called for military service. Fewer experienced operators available for replacement. Inexperienced men to be trained.	Power plants must be operated at maximum capacity and efficiency with fewer skilled operators who, at the same time, must aid in the training of new and inexperienced men.
Fuel 	Transportation difficulties threaten curtailment of fuel shipments causing temporary fuel shortages.	Emergency fuel must be obtained and stored. Available fuel must be burned at maximum efficiency to stretch present supply and to minimize haulage. Must be prepared to burn a substitute fuel if necessary.
Steam	Big increase in steam demand. Lack of generating capacity. New steam generating equipment hard to get even with good priorities.	Every possible pound of steam must be squeezed from present generating units to meet new load demand. Process steam waste must be checked and held to a minimum.
Maintenance	All equipment operating at overload. No stand-by equipment. Replacement parts difficult to obtain. Inexperienced operators.	Maintenance and repairs must be taken care of promptly, in spite of a shortage of experienced maintenance men or difficulties in getting materials, in order to avoid major shut-downs.

REPUBLIC
INSTRUMENTS
AND CONTROLS

FOR SOLVING WARTIME POWER PLANT PROBLEMS

THROUGH the use of instruments and controls you may be able to increase your steam supply just enough to get it over the peak. Republic engineers will be glad to consult with you. Write to us today.

INSTRUMENTS	BOILER CONTROLS	PROCESS CONTROLS
IMPROVE SUPERVISION Instruments provide operators with continuous indications of operating conditions. Permit centralized supervision of all operating factors. Provide continuous record of performance.	**CONSERVE MANPOWER** Automatic boiler controls, by performing the routine repetitive adjustments, free the operators for more important supervisory duties.	**STRETCH SKILL** Automatically perform routine repetitive adjustments to maintain desired conditions thereby enabling the operator to surpervise the operation of a larger number of units.
CHECK LOSSES CO_2 meters, draft gages and flue gas temperature recorders provide a continuous check on combustion efficiency and preventable heat losses. Steam meters serve as a guide for the proper load distribution among boilers.	**SAVE FUEL** Automatically maintain highest combustion efficiency by controlling fuel and air input, in a fixed predetermined ratio, over the normal load range. Provide for changes in fuel characteristics and other operating factors.	**REDUCE WASTE** For every pound of steam wasted and for each extra gallon of watar pumped, etc., a corresponding amount of fuel had to be consumed in the boiler room. Automatic controls reduce power waste and thereby save fuel.
CHECK STEAM WASTE Meters installed on main distribution lines will immediately center attention on the department or unit using excessive amounts of steam. They provide the information needed to coordinate steam consumption with steam production.	**TEST EFFICIENCY** Produce maximum steam output at test efficiency by maintaining constant steam pressure, maximum combustion efficiency, constant and correct furnace draft and desired load division among boilers.	**MORE STEAM** By reducing the power consumption of pumps, compressors, dryers or other steam consuming units, through the use of automatic controls, you increase the effective capacity of your power plant.
LOCATE TROUBLE SPOTS Instruments, by providing a check on the performance of various units, are invaluable in spotting potential trouble spots before they develop to a point where they require extensive repairs and interfere with production.	**REDUCE OUTAGES** Correct boiler operation reduces outages. Boiler controls, by coordinating all operating factors, prevent the chain-of-events type of trouble that may lead to serious shut-downs.	**UNIFORM PERFORMANCE** Maintain correct process conditions under continuous operation at peak capacity. When both operators and equipment are working at capacity close control is vital to prevent serious maintenance outages.

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago, Illinois

Progress and Power in the BUILDING MATERIALS INDUSTRY

Few industries surpass the building materials industry in percentage of growth in the past several years. And certainly no industry will be more important to America's postwar development and progress.

The Public Utilities have been both directly and indirectly responsible for much of the progress by furnishing dependable, low cost power for every need.

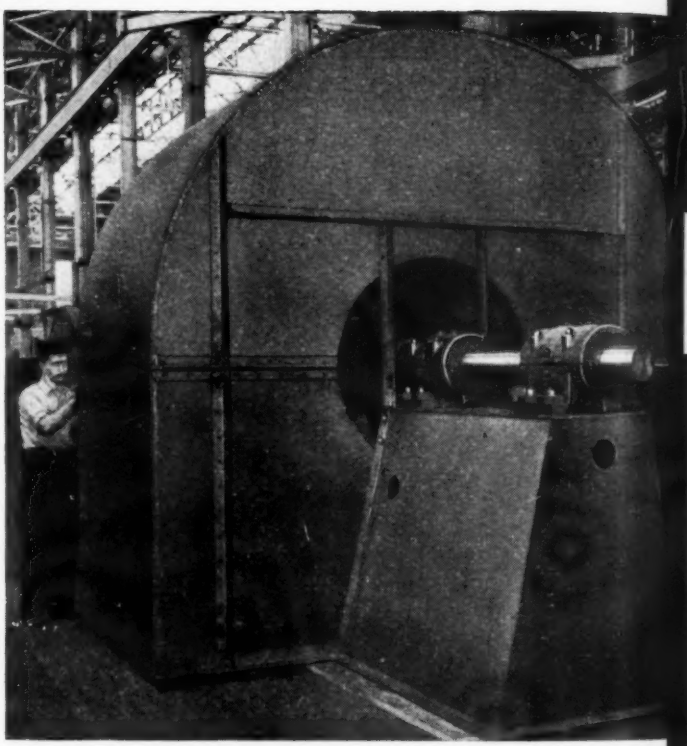
American Blower air handling equipment, mechanical draft fans, dust collectors, exhausters and fluid drives are used not only in the building materials industry but in many of the leading Public Utilities which serve this nation so ably.

AMERICAN BLOWER

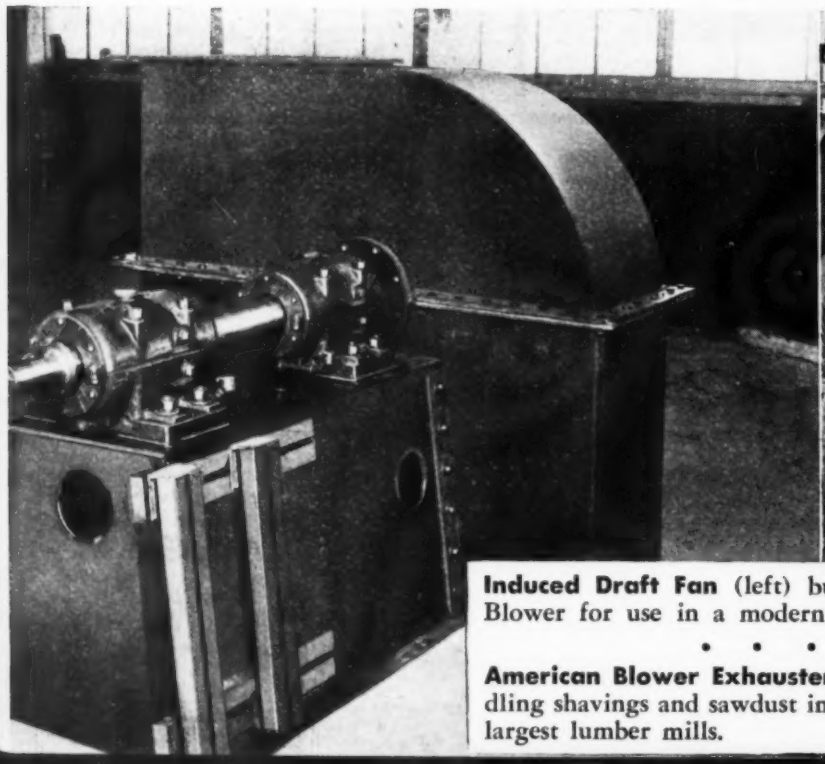
AMERICAN BLOWER

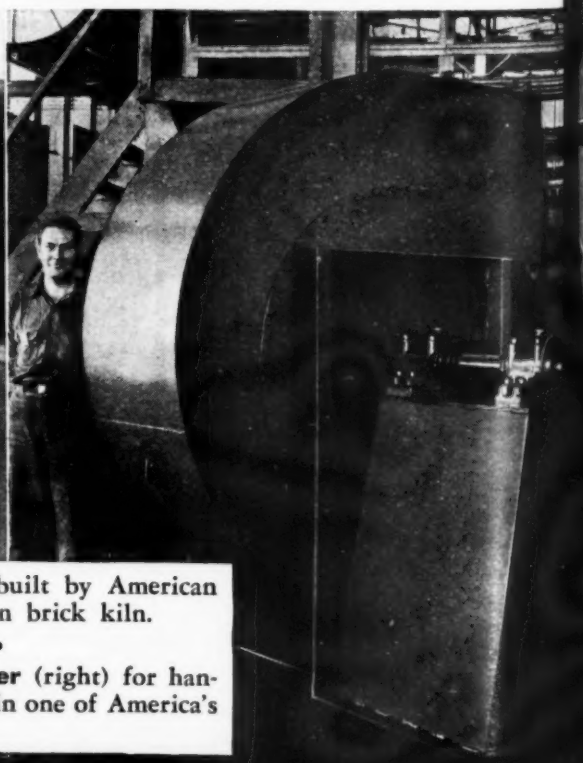
ARMY E NAVY
For Production "Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary corporation



American Sirocco Fan being readied for shipment to a nationally known plasterboard plant.

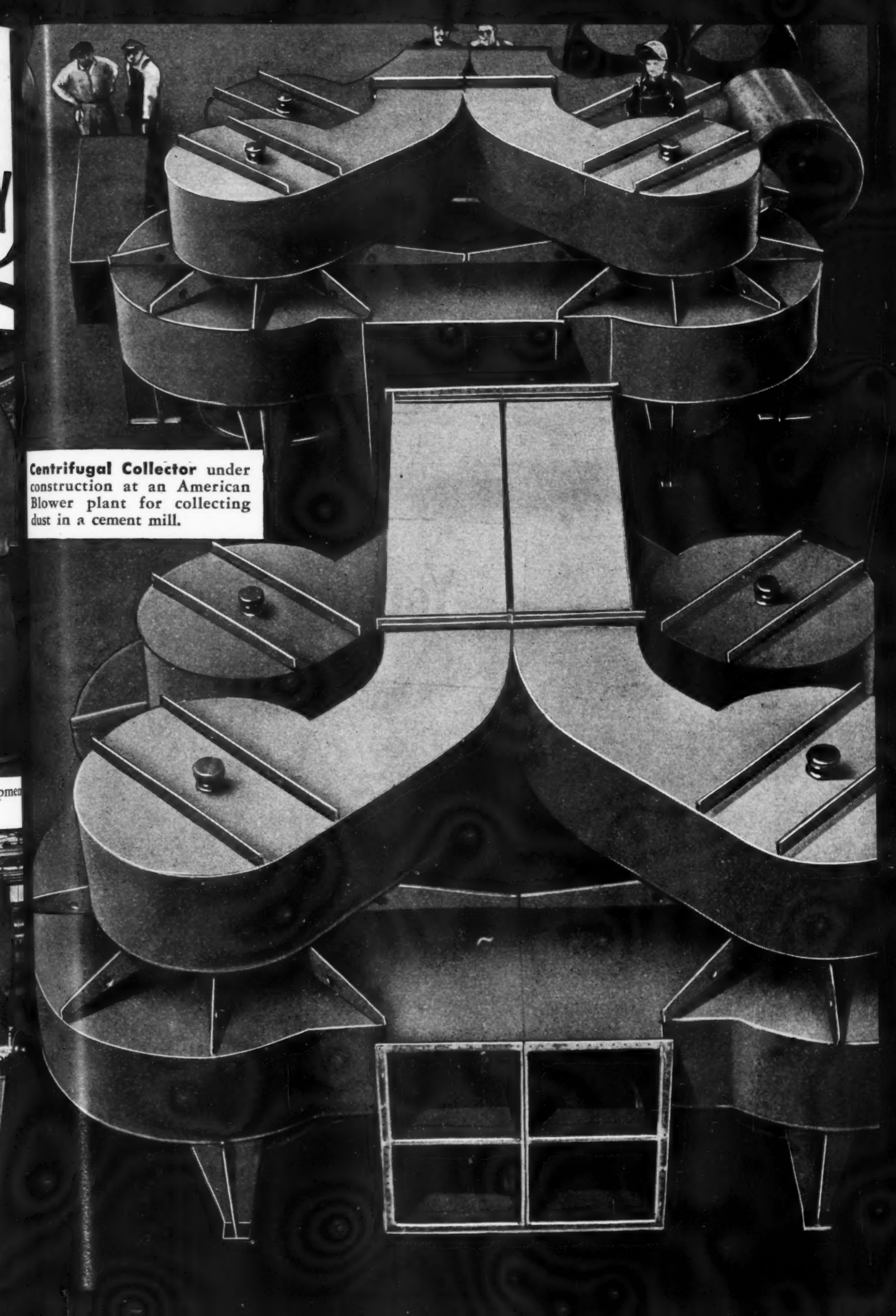




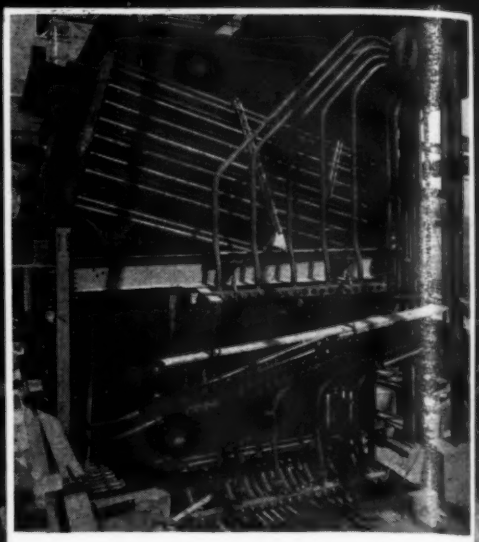
Induced Draft Fan (left) built by American Blower for use in a modern brick kiln.

• • •

American Blower Exhauster (right) for handling shavings and sawdust in one of America's largest lumber mills.



Centrifugal Collector under construction at an American Blower plant for collecting dust in a cement mill.



Two 1000-hp. Box Header type boilers built with NATIONAL Seamless Boiler Tubes. Now in continuous operation under peak war loads.

You, too, will be glad

Layout Floor at a NATIONAL boiler tube plant. Full scale diagrams are used to make absolutely certain that boiler tubes fit when they are assembled in the field.

Red-hot boilers. NATIONAL Seamless Tubes on new U. S. destroyers must be able to operate at a cherry-red without failure. This puts a terrific strain on the tubes but it enables a destroyer to get up steam in a fraction of the time formerly required.

551,388 miles per set of National Seamless Boiler Tubes. That's the amazing average set by 11 locomotives running from San Francisco to Kansas City, Mo. One engine rolled up a total of 695,118 miles before tubes were changed.

you used Seamless Boiler Tubes

THE war has forced boiler tube users to get the maximum possible service out of every tube. Durability has become the prime factor, with safe operation under overloads running a close second. Important, too, is the ability of a tube to withstand manipulation punishment both in original installation and subsequent resetting of the tubes. Here's how Seamless is standing up under war conditions:

More and more reports are coming in which show NATIONAL Seamless Tubes are giving up to double the life of non-seamless tubes. This is due chiefly to three factors—higher grade steel to begin with, no welds, and uniform wall strength throughout.

Other reports emphasize that when boiler equipment is fabricated from seamless tubes, all uncertainty about its tubes is removed, that there need be no fear that under the rigors of modern conditions some slight, discontinuity in a weld will provide the starting point for a disastrous failure.

Still other Master Boiler Makers report that NATIONAL Seamless Tubes can be more readily bent, expanded, flanged, beaded, and rolled tightly into headers without splitting or fracture. They say these are practical qualities that boiler makers always appreciate.

When conditions ease up and more boiler tubes become available, remember the experience of these seamless users and why they are glad they used Seamless.

Steel needs scrap NOW . . . . send it in!

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

NATIONAL SEAMLESS

USS

UNITED STATES STEEL

The TERRY

TERRY
SOLID WHEEL TURBINE ADVANTAGES . . .

— The blades and the wheel (see above) are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double rim protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

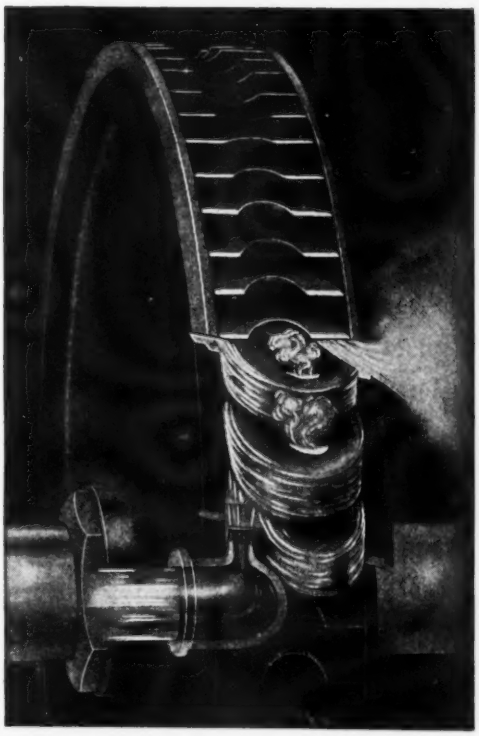
— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— As the only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

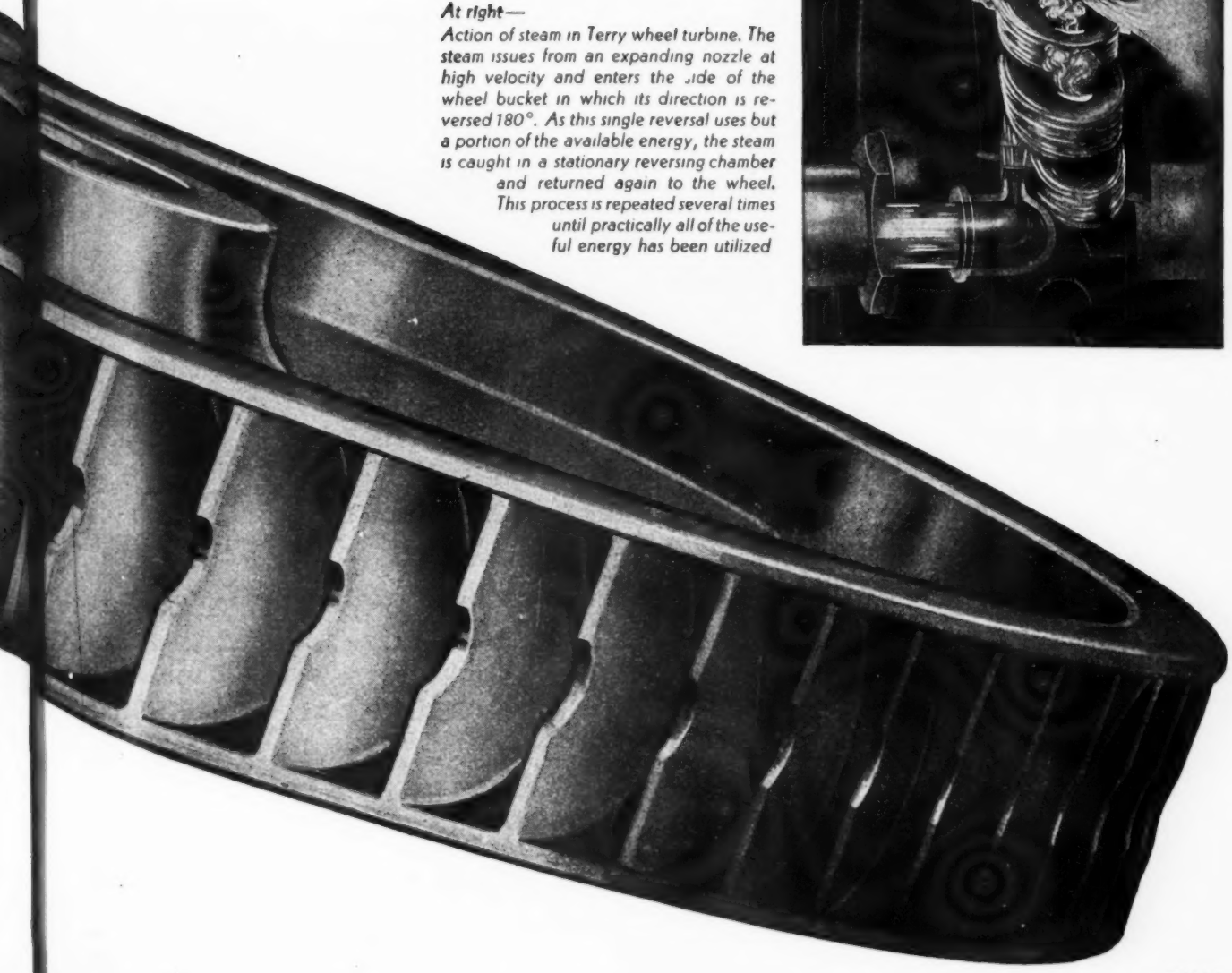
— The Terry wheel will withstand abuse that would wreck any built up wheel.

THE TERRY STEAM TURBINE CO.

Wheel Turbine



At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized



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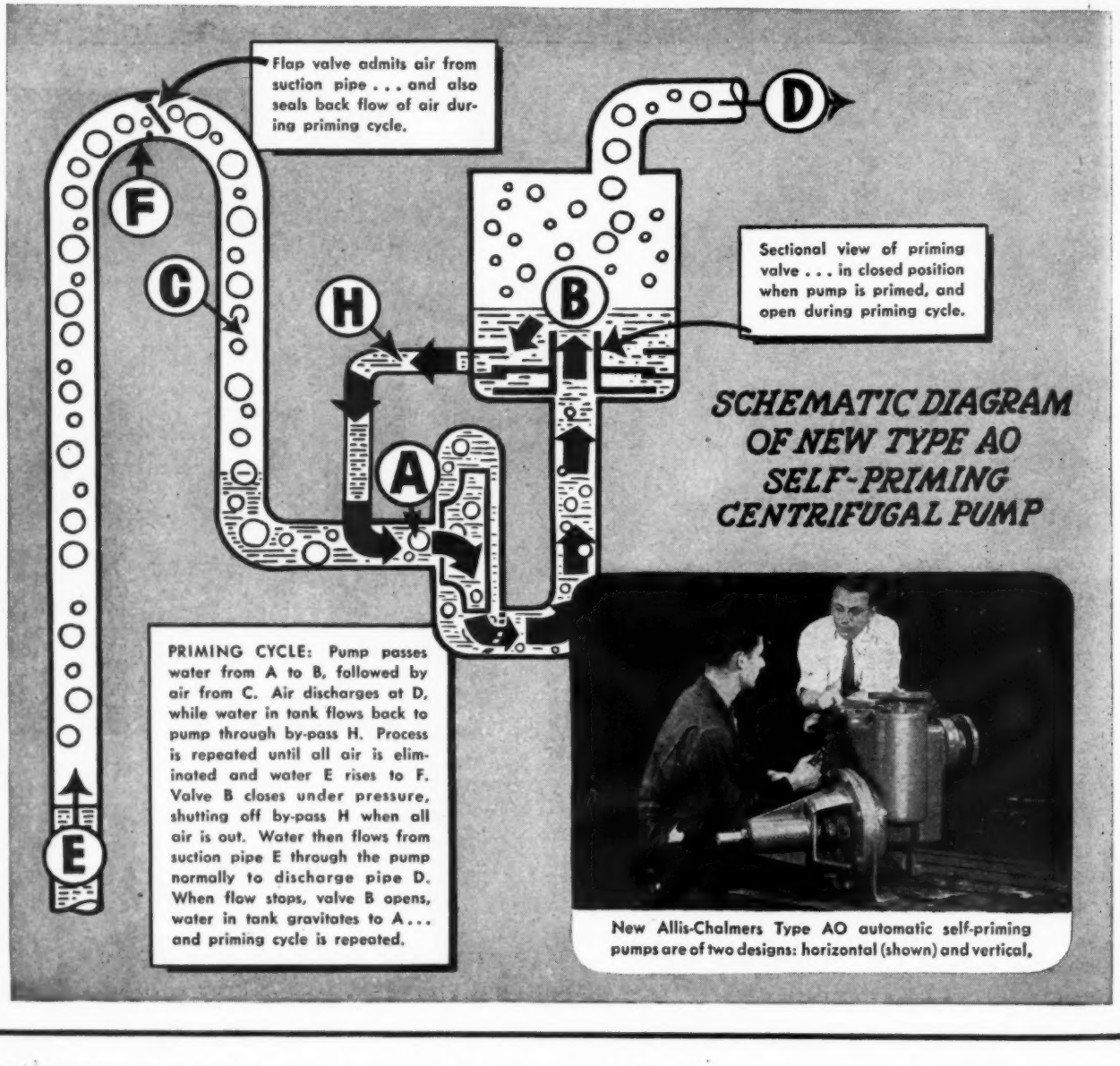
TERRY SQUARE - HARTFORD, CONN.

PRODUCT OF THE MONTH


Flap valve admits air from suction pipe . . . and also seals back flow of air during priming cycle.
Sectional view of priming valve . . . in closed position when pump is primed, and open during priming cycle.
SCHEMATIC DIAGRAM OF NEW TYPE AO SELF-PRIMING CENTRIFUGAL PUMP
PRIMING CYCLE: Pump passes water from A to B, followed by air from C. Air discharges at D, while water in tank flows back to pump through by-pass H. Process is repeated until all air is eliminated and water E rises to F. Valve B closes under pressure, shutting off by-pass H when all air is out. Water then flows from suction pipe E through the pump normally to discharge pipe D. When flow stops, valve B opens, water in tank gravitates to A . . . and priming cycle is repeated.
A
B
C
D
E
F
H
New Allis-Chalmers Type AO automatic self-priming pumps are of two designs: horizontal (shown) and vertical.

MILWAUKEE, WIS.—Allis-Chalmers announces a new automatic self-priming centrifugal pump, Type AO, which insures high efficiency through use of a new-type spring valve. The AO is especially adaptable to applications where speed of installation is important. Available for high priority jobs. A 1668

WE WORK FOR VICTORY — WE PLAN FOR PEACE

ALLIS-CHALMERS · MILWAUKEE · WISCONSIN

KENNEDY
BRONZE GATE VALVES

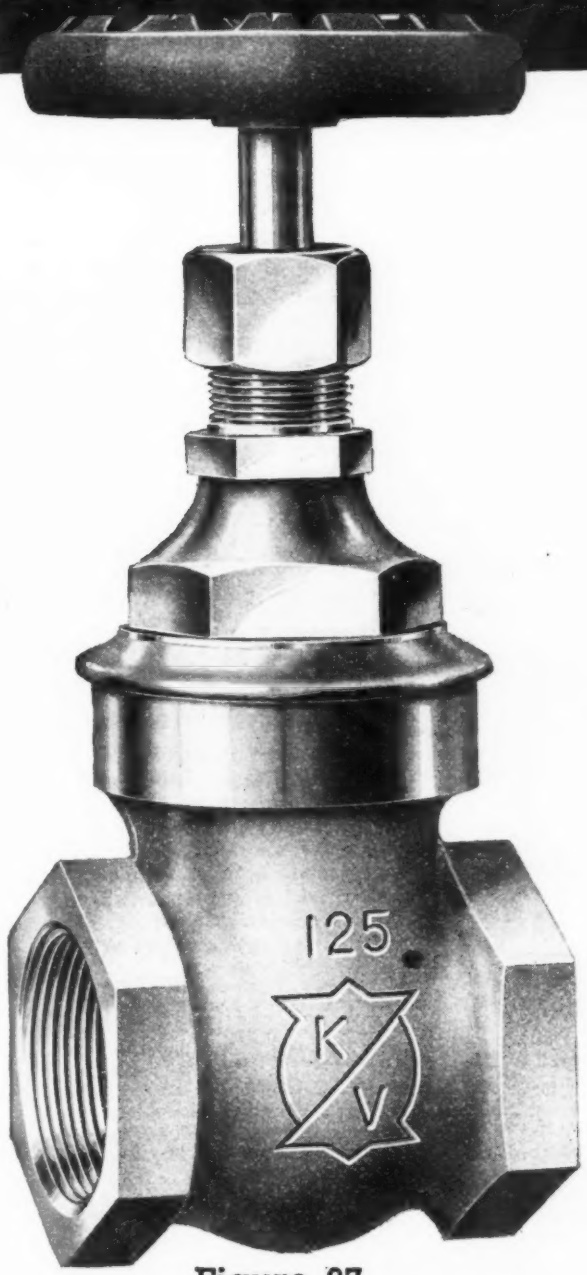


Figure 27
Standard, Screwed Ends

Simple
Sturdy
Durable

Assure easy operation, and lastingly trouble-free service. Available in non-rising and rising stem types; also outside screw and yoke. Built for steam pressures up to 300 lbs.

Buy From Our Distributor

THE KENNEDY VALVE MFG. CO.
ELMIRA, N. Y.

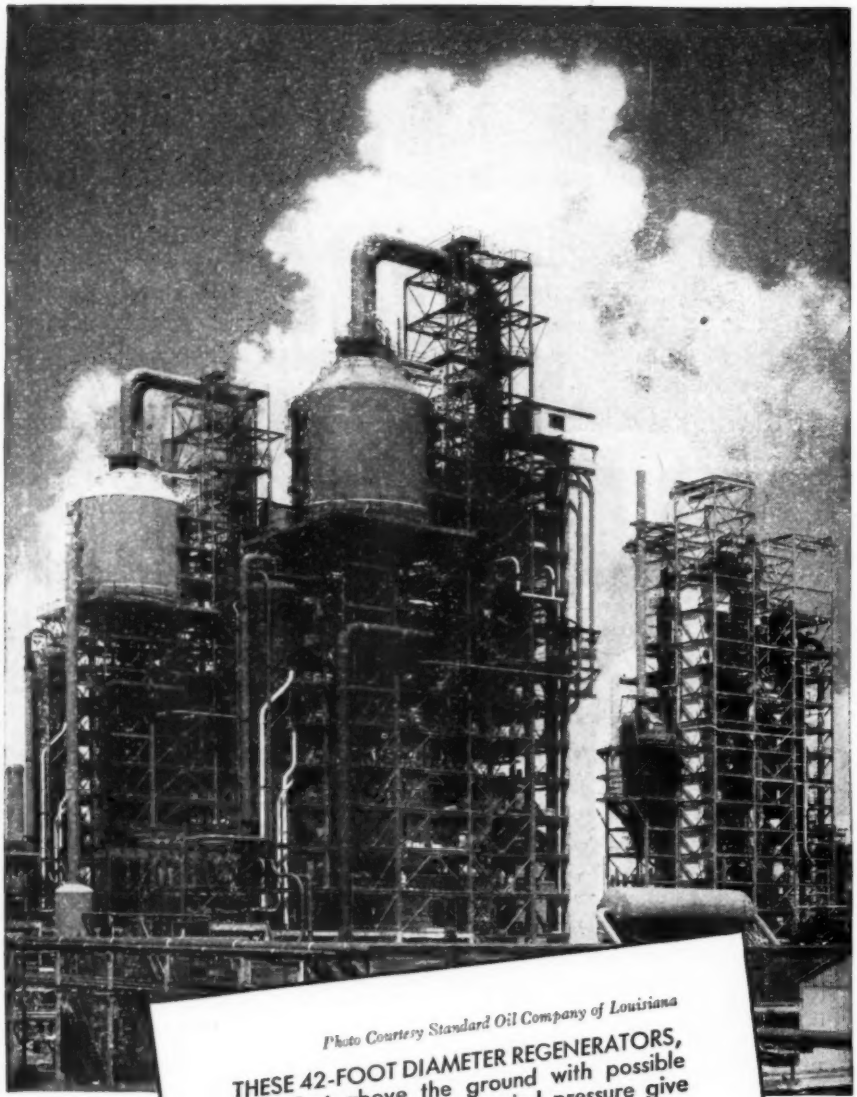


Photo Courtesy Standard Oil Company of Louisiana

THESE 42-FOOT DIAMETER REGENERATORS, 200 feet above the ground with possible resulting distortion from wind pressure give some idea of the need for thorough structural adequacy of any kind of lining. The tremendous size of these vessels can be visualized from the fact that 8300 sq. ft. of Bigelow-Liptak wall is used in one such unit as compared with an average large industrial boiler having 1000 sq. ft.

Case #2437

A Bigelow-Liptak First

THIS STORY TELLS how Bigelow-Liptak became the first to apply thin suspended walls to catalyst regenerative linings. Today there are more Bigelow-Liptak vessel linings in service and under construction than all other types combined.

There are dozens and dozens of enclosure problems. Each one is different. Each has its peculiar characteristics and special obstacles. There can be no standard solution for every case. That is why each case is an individual problem with Bigelow-Liptak engineers. Each is thoroughly studied. Nothing is "standardized" or taken for granted. Each job is completely pre-engineered. Everything is worked out and planned to the last detail. Nothing is left to chance. Even the manufacture of materials is closely supervised to assure closest adherence to tolerance. All of this tells why Bigelow-Liptak jobs are successful—and this is why it will pay you to do as so many others are doing and take your enclosure problems to Bigelow-Liptak.

Features of Bigelow-Liptak Vessel Linings

Features of Bigelow-Liptak thin suspended vessel linings are many: *(1)* ***Use a minimun of critical materials,*** *(2)* ***Relatively low cost,*** *(3)* ***Resist abrasion and corrosion,*** *(4)* ***Permits use of ordinary steel,*** *(5)* ***Prolong life of lining,*** *(6)* ***Permit larger sizes,*** *(7)* ***Eliminate expansion and contraction problems,*** *(8)* ***Reduce weight of lining.***

Do You Have an Enclosure Problem?

Bigelow-Liptak engineering is today solving new and old problems in all types of heat enclosures. Its record of successful installations through the years and its ability to solve new problems as they arise are based upon individualized engineering for each problem and the application of sound engineering principles that will give the user the best and most economical solution to his particular needs.

BIGELOW LIPTAK Corporation

Unit-Suspended Walls + Arches

The Key to Operating Economy

BIGELOW-LIPTAK CORPORATION

DIVISION A. P. GREEN FIRE BRICK CO.

330 Curtis Building

DETROIT

HOW BIGELOW-LIPTAK CONSTRUCTION TURNED A MATERIAL SHORTAGE INTO *a Production Advantage*

There was little or no alloy steel available for the oil industry but Bigelow-Liptak engineers developed a new way to do this job—even better.

PRIOR TO WORLD WAR II, special alloy steels were used for process vessels and pipe construction in the manufacture of high octane gasoline. The limited demand for this aviation gasoline required relatively small plants and correspondingly small process vessels. Aside from cost, the use of such special alloy steel caused no problem.

With the start of the war, unlimited quantities of steel had to be diverted to tanks, guns, ships and vital weapons. War which was hastening the expansion of the oil industry for needed production of high octane gasoline and butadiene was, at the same time, curtailing this industry's supply of alloy steel. There was not enough for every need. Substitutes or new methods which would eliminate the use of alloy steel would have to be found or developed.

The Problem

How could the manufacture of synthetic rubber and high octane gasoline be expanded without the use of special alloy steels for certain process vessels and pipes? Larger chambers and many more of them were needed for war production. The burning off of the hydrocarbons from the used catalysts in the regenerative vessels results in temperatures of 1000° to 1200° F. — which is too high for unlined plates of carbon steel which could be obtained.

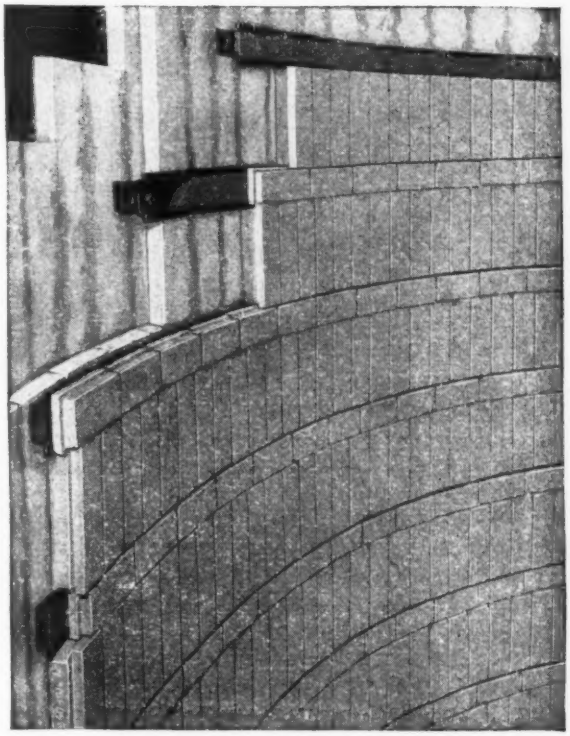
A solution had to be worked out, but refinery engineers had to be assured linings would be adequate with greatest possible chance of survival. Failures would upset entire aviation gasoline program.

Bigelow-Liptak had already earned a reputation for applying suspended wall construction to low temperature areas where thin refractories were adequate but suspended walls were necessary to take care of expansion movements. So it was natural that Bigelow-Liptak was called in.

The Solution

In the catalytic cracking processes for manufacture of butadiene and high octane gasoline, vapors are passed into large chambers or reactors where they come in contact with the catalyst. The catalyst cracks the vapors to the higher form and in doing so, gathers carbon deposits. After a certain period in use, the catalyst must be reactivated by having the accumulated hydrocarbons burned off in closed chambers. The solution for lining these regenerators was found in Bigelow-Liptak suspended thin refractory walls. By using this Bigelow-Liptak development the shells could now be made of carbon steel since the suspended walls supplied protection against corrosion, erosion and heat. The refractory easily supplied the qualities necessary for such a wall while suspended construction supplied the means of using the refractory and keeping it in place.

Here is a case in which a war problem has brought about an improved and more satisfactory method. The permanence of Bigelow-Liptak vessel linings makes it evident that the old method of using alloy steel for vessel linings has been successfully replaced.



INTERNAL VIEW DURING CONSTRUCTION of 3-inch Bigelow wall lining a 25-foot diameter fluid catalyst regenerator. Note minimized contact between wall brackets and shell. The brackets themselves are completely inside the insulation shell and are connected merely by small metal clips welded to the outer shell. Notice bracket recesses filled with insulating cement. Note staggered joints between two laminations or layers of main asbestos insulating blocks. Cylindrical portions of vessels are completely lined by using Bigelow wall shapes.

Here is a ruggedly supported and, therefore, a structurally sound, adequate enclosure which permits the use of thinner refractory linings because the refractories are relieved of load bearing. Expansion and contraction is taken up within the individually supported unit. Regardless of height of lining, there is no accumulation of expansion. Insulation between the refractory and the shell is not disturbed. Sealed insulation minimized thermal losses and catalyst erosion.

FREE
Interesting Catalogs

Bigelow-Liptak's wide engineering experience in designing enclosures includes every type of problem having to do with thermo-dynamics, ceramics, and mechanics of materials.

Our engineering staff will be glad to send you interesting catalogs or tell you how you could secure increased service and economy by the use of Bigelow-Liptak Unit-Suspended walls and arches in your plant. Fill out the coupon at right and mail today for your free copies.

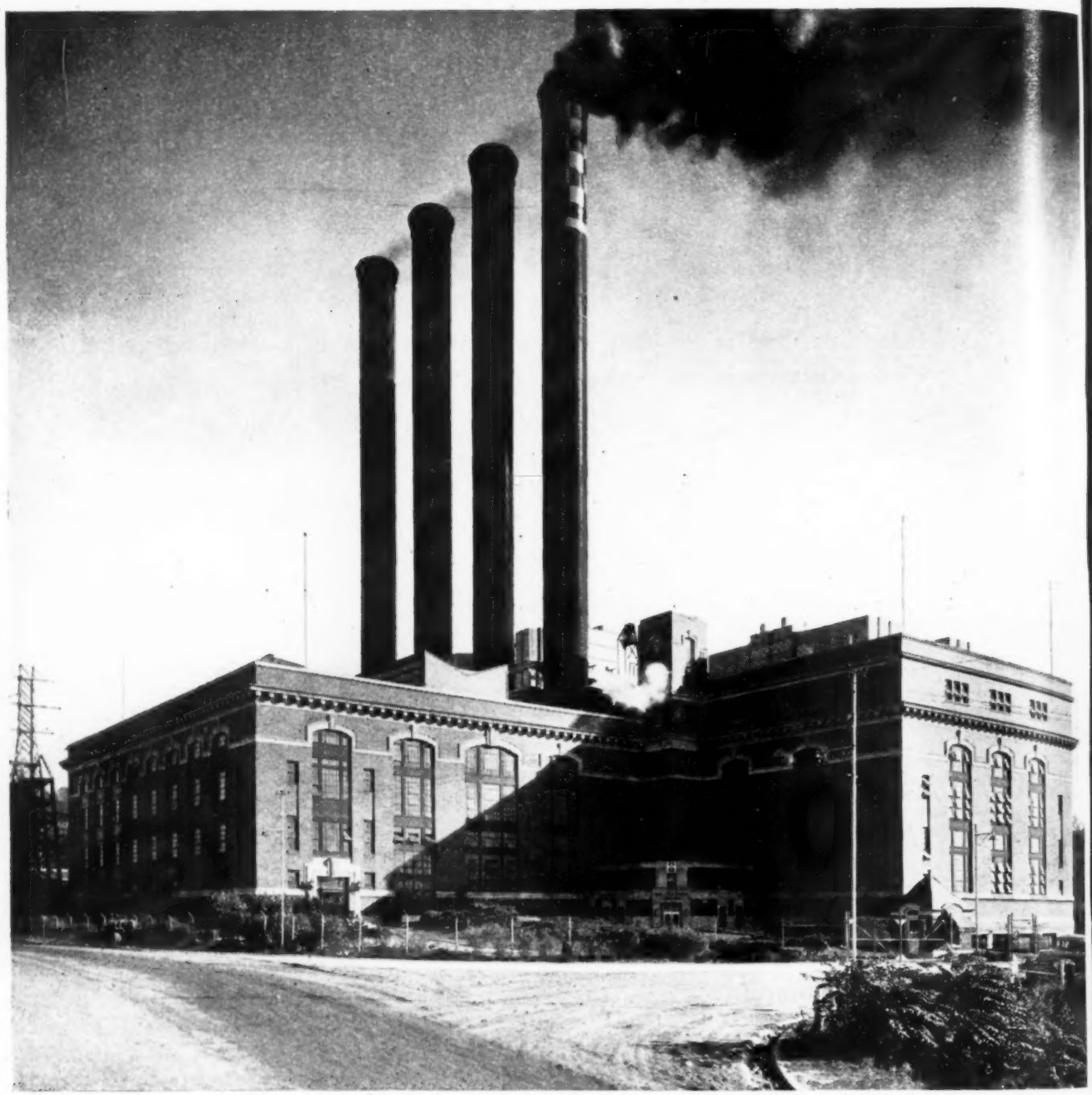
BIGELOW-LIPTAK CORP.
330 Curtis Building, DETROIT

Please send me copies of your free catalogs showing advantages of Bigelow-Liptak Unit-Suspended Walls and Arches.

Name .....

Company .....

Address .....



Pictured above is one of the latest and most modern power plants in the United States. In it every piece of machinery and equipment was selected with the utmost care by experts. They, too, like so many other leaders in the industrial world, believed it wise to "ask POWELL for the answer to their valve requirements". Throughout the plant you'll find the valves bear a name that has stood for excellence for 98 years—POWELL.

POWELL

Ask POWELL for the Answer to all your VALVE requirements

For every operation in the power field that requires flow control, POWELL has the correct valve. The three valves shown here are especially suitable for *low-pressure steam* and *water* lines.

Fig. 241—Iron Body Bronze Mounted Globe Valve for 125 pounds W. S. P. at 450 F. Has flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. This type of valve is also available for 250 pounds W. S. P. Sizes 2" to 12", inclusive.

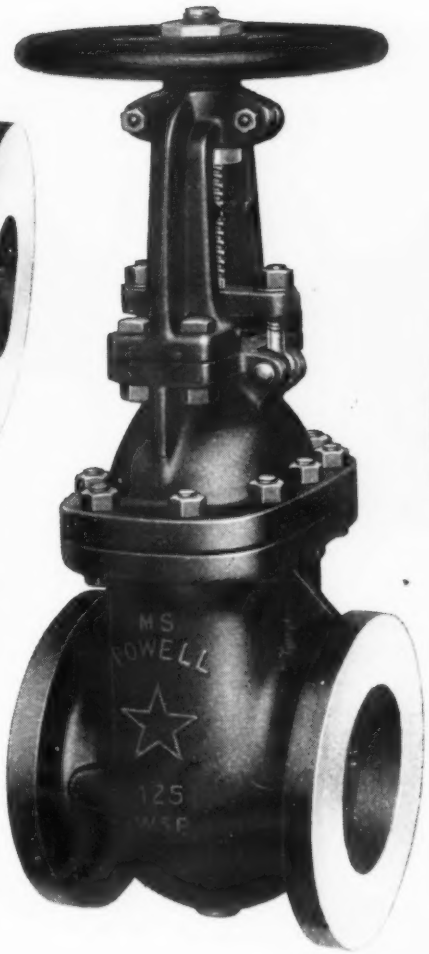


Fig. 1793—Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. at 450 F. (12" and smaller), 100 pounds W. S. P. (14" and larger). Has flanged ends, outside screw rising stem, bolted flanged yoke, bronze seat and taper wedge solid disc. Sizes 2" to 30", inclusive. Also available for 250 pounds W. S. P. in sizes 2" to 24", inclusive. Where desired this valve can be furnished with double disc wedge.

Fig. 559—Iron Body Bronze Mounted Swing Check Valve for 125 pounds W. S. P. at 450 F. Has flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Sizes 2" to 12", inclusive. Also available for 250 pounds W. S. P. in sizes from 2" to 10", inclusive.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati, Ohio

VALVES

HALL P-T-X SYSTEM

• the added factor in a f

Hall research has scored another first in its development of the

P-T-X System to control deposition in boilers and turbines

and to prevent corrosion from bonded oxygen

WHEN medical science perfects a remedy for a baffling disease, your physician is that much better fortified to keep you in good health.

The same holds true in the treatment of boiler ills. The new Hall P-T-X System for coping with certain boiler conditions which have heretofore resisted every attempt at a solution, makes Hall Service of preventive care more than ever a modern necessity.

To prospective users of Hall Boiler Service this gives an added promise of freedom from troubles arising from boiler water conditions. To the hundreds of leading plants which have consistently used this service, it is new evidence of the security it affords.

Preventive care, practiced by the Hall Laboratories trained field personnel, owes its successful performance to one factor which should mean more to you than any other—Hall Laboratories' unceasing research.

Every boiler ill reveals itself through symptoms to the trained observer. Preventive care is a system which enables you to detect these symptoms and apply a remedy before it is too late. This individualized operation explains the overwhelming success of Hall Serviced power plants. May we give you further particulars?

Siliceous scales can now be reduced or eliminated ➡ ***(see photo)*** **in high and low pressure boilers by the new Hall P-T-X system based on a potassium equilibrium instead of sodium. This is a *new* treatment *added* to Hall Service to meet certain conditions. It *does not* replace or make obsolete the present Hall System.**

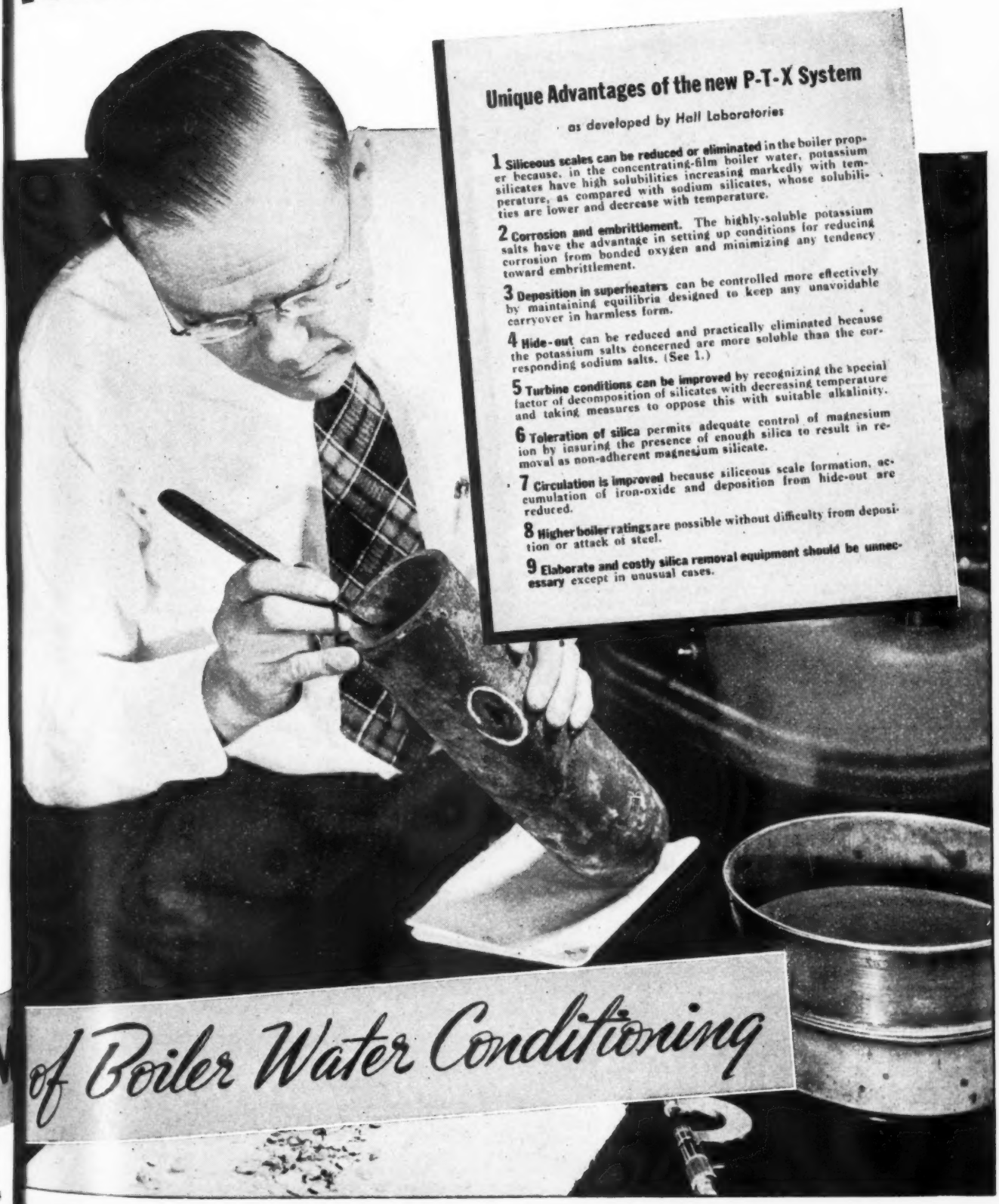
HALL LABORATORIES, INC. · HAGAN BUILDING · PITTSBURGH 30, PA.

A SUBSIDIARY OF HAGAN CORPORATION

HAGAN HALL BUROMIN CALGON

HALL SYSTEM

famous boiler service



Unique Advantages of the new P-T-X System

as developed by Hall Laboratories

1 Siliceous scales can be reduced or eliminated in the boiler proper because, in the concentrating-film boiler water, potassium silicates have high solubilities increasing markedly with temperature, as compared with sodium silicates, whose solubilities are lower and decrease with temperature.

2 Corrosion and embrittlement. The highly-soluble potassium salts have the advantage in setting up conditions for reducing corrosion from bonded oxygen and minimizing any tendency toward embrittlement.

3 Deposition in superheaters can be controlled more effectively by maintaining equilibria designed to keep any unavoidable carryover in harmless form.

4 Hide-out can be reduced and practically eliminated because the potassium salts concerned are more soluble than the corresponding sodium salts. (See 1.)

5 Turbine conditions can be improved by recognizing the special factor of decomposition of silicates with decreasing temperature and taking measures to oppose this with suitable alkalinity.

6 Toleration of silica permits adequate control of magnesium ion by insuring the presence of enough silica to result in removal as non-adherent magnesium silicate.

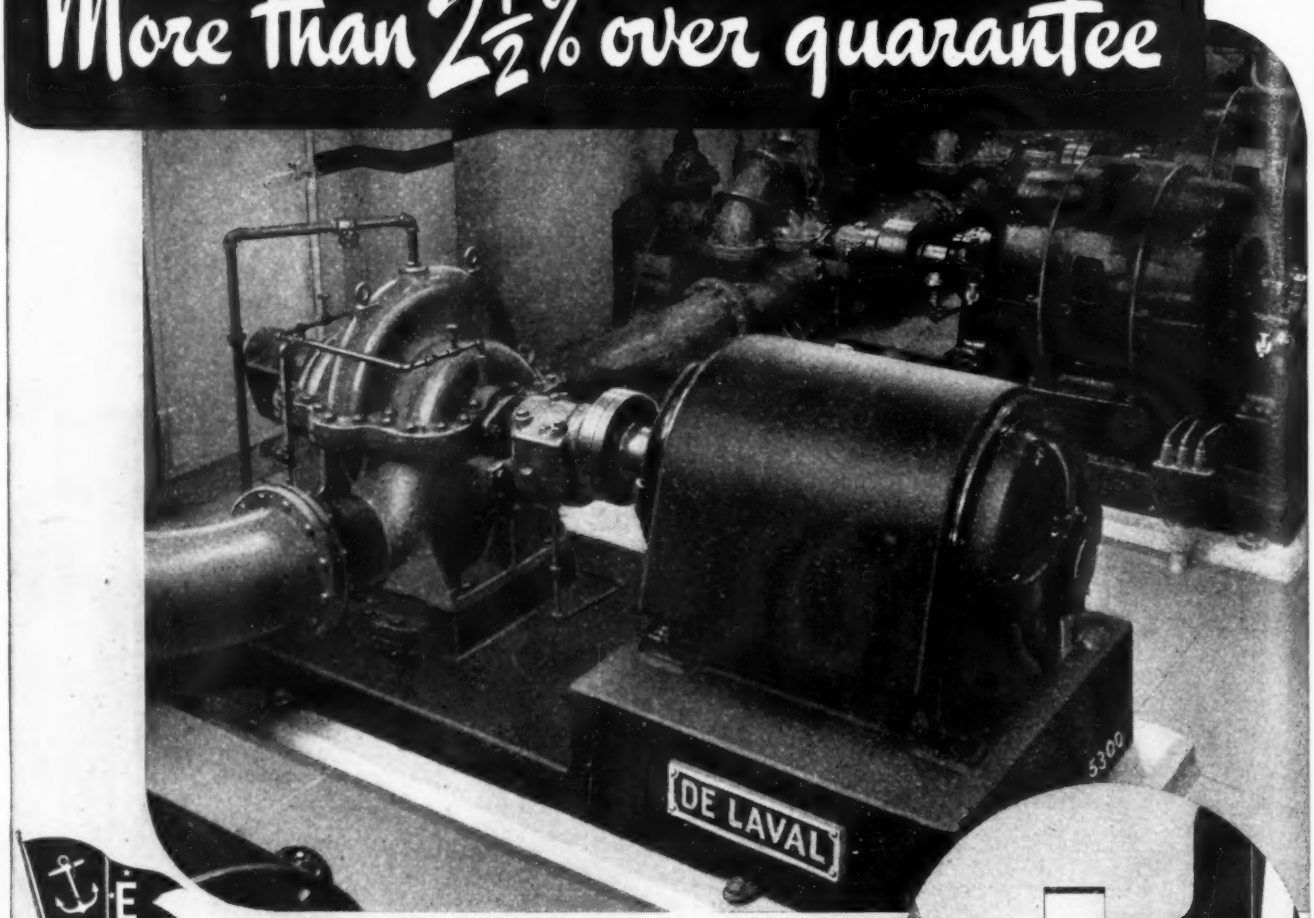
7 Circulation is improved because siliceous scale formation, accumulation of iron-oxide and deposition from hide-out are reduced.

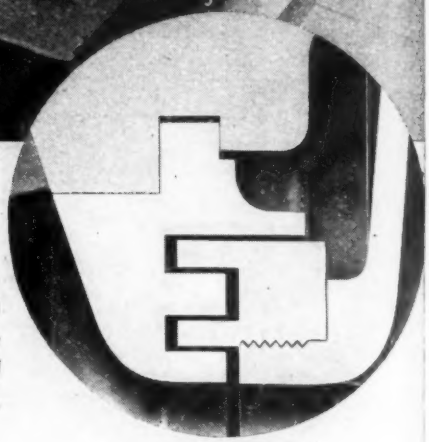
8 Higher boiler ratings are possible without difficulty from deposition or attack of steel.

9 Elaborate and costly silica removal equipment should be unnecessary except in unusual cases.

of Boiler Water Conditioning

More than 2½% over guarantee





Cross section of De Laval double labyrinth wearing rings; one ring is held by the casing, while the other is screwed onto the impeller.

The DE LAVAL MOTOR DRIVEN PUMP in the foreground was supplied to a Canadian public utility under a guarantee to deliver 4000 Imperial gallons per minute against a total head of 217 ft. with a wire-to-water efficiency of 78 per cent.

In the official acceptance test by the customer's consulting engineer, this was exceeded by more than 2½ per cent.

The Utility has now ordered for standby service a similar De Laval pump of 5000 Imperial gallons capacity against the same head and driven by a gasoline engine.

The sustained high efficiency of De Laval pumps is made possible by correct hydraulic design and, in large part, by the DE LAVAL LABYRINTH WEARING RINGS, without resort to the close clearances necessary with flat rings. These, and other parts subject to wear, are easily renewable, as they are made to limit gages to be interchangeable.

2538

DE LAVAL *Steam Turbine Co.*
TRENTON, N.J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL and FLEXIBLE COUPLINGS

FEBRUARY 1944

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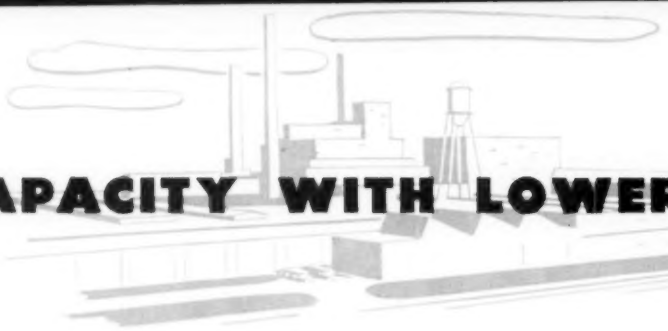


MORE CAPACITY WITH LOWER GRADE COA

Fuel-wise plants are now converting their boiler units to use local low-fusion ash coals. This change-over saves over-all fuel costs and guarantees a fuel supply that will last, at present mining rates, for centuries.

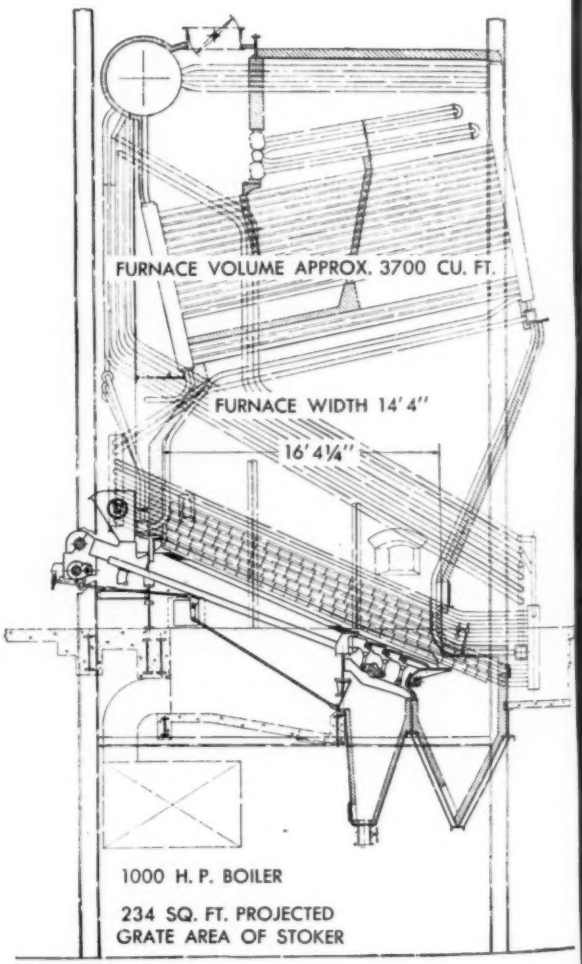
For example, Power Engineers of the American Viscose Company were faced with this problem: One of their largest plants, although located near a major coal field, could not burn local coal with existing equipment. Premium coal, hauled several hundred miles, was expensive and becoming more difficult to obtain. Even with premium coal, load demands could not be satisfied.

The solution: An installation of four Westinghouse Link-Grate Stokers. By this conversion, load demands are met easily with low grade coal. The company is assured of a plentiful coal supply and savings in cost of fuel resulted in an unusually attractive return on the investment. And the first stoker, operated 11,530 hours before it was necessary to replace any stoker parts.

J-50449

CONVERSION DATA

Boiler—Edge Moor—Cross-drum	1,000 hp
Steam Pressure	250 psi
Steam Temperature	580°F.
Feed-water Temperature	225°F.
Stoker—Westinghouse M. R.—	
Continuous Ash Discharge	8 Retort SDL No. 16
Rating, Maximum Continuous	90,000 lbs. per hr.



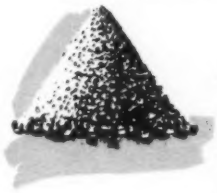
BEFORE YOU BUY . . .

Look at the Link-Grate

THROUGH *Link-Grate* CONVERSION

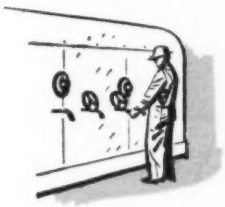
and here's why—

BURNS LOW COST COAL



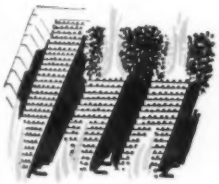
A Link-Grate Stoker will burn any grade of bituminous coal—and burn it effectively. The "up and down" Link-Grate motion maintains a regular combustion rate by continuously processing the fuel bed—keeping it porous—maintaining a uniform flow of gases going through the combustion zone.

REQUIRES FEW ADJUSTMENTS



Once the basic cycle of operation is established for a particular boiler load and type of fuel, thorough combustion is practically automatic. The few adjustments necessary can be made easily—quickly. Constant Link-Grate movement prevents ash accumulations—keeps ash discharge continuous.

HAS UNRESTRICTED FUEL BED FLOW



The Link-Grate motion facilitates normal movement of the fuel bed over the underfeed section—even at low loads. There are no clinker problems because burning lanes are kept clear. Pores are never closed to cause large clinker formation.

HANDLES ALL TYPES OF LOADS

Link-Grate Stokers meet any steam demands on the boiler. Since Link-Grate motion keeps the fuel bed porous under all conditions, the fire is always sensitive to air flow. Changes in air supply, corresponding to changes in steam demand, are effective immediately.

The Westinghouse Stoker Engineer near you will be glad to show you a Link-Grate Stoker installation in your locality. Just call your nearest Westinghouse office for details. Westinghouse Electric & Mfg. Company, East Pittsburgh, Pennsylvania.

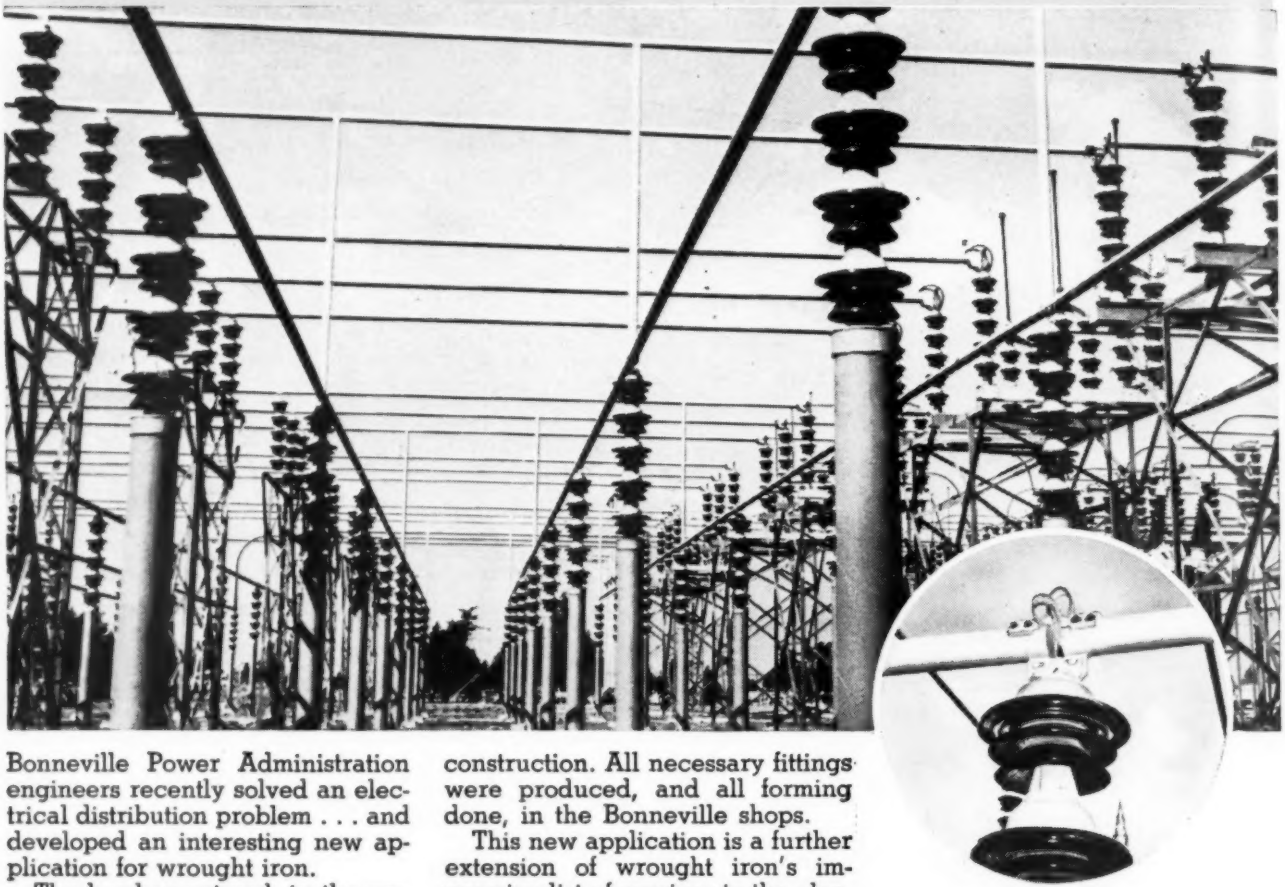
Westinghouse PLANTS IN 25 CITIES... OFFICES EVERYWHERE **STOKERS**

WESTINGHOUSE

Engineering ingenuity—and

GENUINE WROUGHT IRON

solved this electrical distribution problem



Bonneville Power Administration engineers recently solved an electrical distribution problem . . . and developed an interesting new application for wrought iron.

The bus-bar network in the system substations would have required a prohibitive amount of the non-ferrous metals ordinarily used, and so alternates were carefully investigated. The material found to possess the most desirable combination of strength, conductivity, corrosion resistance, ease of fabrication, simplicity and economy, was wrought iron. Furthermore, the engineer's report cited several points in its favor for use in *permanent* buses: carrying capacities at 115kv and 230kv sufficient to handle current from the largest stations . . . physical properties that permit the use of long spans . . . good corrosion resisting qualities in moist atmospheres . . . lower cost . . . less expansion, and so fewer expansion joints . . . easy, quick and economical welding . . . and adaptability to "streamlined" construction. All necessary fittings were produced, and all forming done, in the Bonneville shops.

This new application is a further extension of wrought iron's impressive list of services to the electrical field. Widely used as heavy-wall conduit, to protect electrical cables in river and bridge crossings and underground runs, it is also serving in transformer cooling coils and cases; in switch boxes installed in corrosive surroundings; in electrodes in salt annealing furnaces; precipitation plates for carbon production; in ground and lightning rods, and lightning masts; and for generator housings, stator yokes on aircraft amplidynes, and motor generator frames. In each case, the application was initiated by the engineer involved, based on his knowledge of wrought iron's characteristics.

Perhaps Byers Wrought Iron can help you solve some electrical problem. In any event, it can serve you in some capacity. To get a picture of the many jobs wrought iron is doing . . . and some ideas as to where it might save for you . . . ask for our bulletin, "101 Uses for Wrought Iron."

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BYERS

GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE ALLOY STEELS • OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS

EXTRA SCRAP IS ESSENTIAL TO BOLSTER STEEL PRODUCTION . . HELP COLLECT IT!

Free Enterprise

. . . INCENTIVES AND TAXATION

There are three principal ways of making a living:

1. Getting on someone's payroll
2. Lending one's savings to business enterprises
3. Starting, or helping to start, a business enterprise

About three out of four of us fall in the first group—we are ***job-holders.*** Millions of us get some income, large or small, by lending our savings—directly or through such channels as insurance companies. We are suppliers of ***loan-capital.*** About one out of four of us has his own business enterprise, and several millions of us are part owners of business enterprises. Those of us who go into business for ourselves and those of us who are part owners of enterprises are ***job-givers.***

The amount of employment in a community depends, in the main, on the number of persons who attempt to make their living, or part of their living, by giving jobs to others, rather than by getting on someone's payroll. A community seriously desiring a high level of employment and a high standard of living will strive to make job-giving attractive and to encourage a large part of its population to be job-givers rather than merely job-holders.

The number of men who attempt to make their living in whole or in part by starting new businesses or by expanding old ones depends upon the outlook for profits. When the outlook for profits improves, thousands of new jobs open up and thousands of men go to work; and, as men go to work, the farmer and everybody else benefits. When the prospect for profits becomes darker, the demand for labor, capital, and raw materials drops. It may be roughly estimated that an improvement in the prospect for profits of one billion dollars raises the demand for labor by anywhere from two billion dollars to five billion dollars.

One of the principal determinants of the outlook for profits is the amount and the nature of taxes. After the war, the Federal government will need to raise each year about twenty billion dollars in taxes—three times the amount required before the war, and six times the amount re-

quired in the Twenties. In the Twenties, the tax needs of the Federal government were roughly twice as large as corporate profits in a good year. After the war, Federal revenue needs will be roughly three times corporate profits in a good year. Obviously, it will be much more difficult, after the war, for the government to meet its needs *without discouraging enterprise,* and therefore without diminishing the number of jobs, than it was before the war. Far more than ever before, it will be necessary for the government in developing a tax program to take account of the effect of taxes upon employment and the standard of living. This means that it will be important for each and every citizen to give attention to these matters—because the policies of the government reflect, in the main, the thinking of the citizens.

Some taxes seriously discourage individuals and business firms from undertaking new and enlarged operations. Other taxes have little or no adverse effect on investments. Some taxes are a burden on consumption, affecting the sales of specific commodities, depending on the nature of the taxes. It is obvious that different kinds of taxes have different economic influences. *We must understand the forces that determine the level of employment and consider the tax program in relation to other measures designed to create more jobs.*

What are the tests of a good tax system?

1. **Taxes should be designed to encourage production and enterprise and to make it attractive for a large number of people to earn all or part of their living by giving jobs to others.**

2. **Taxation must be fair in principle and administration, with no discrimination between persons in similar circumstances.**

3. **Taxes should be apparent and not concealed, and should be levied, in the main, directly upon individuals so that each of us will know how much our government is costing him. A moderate income tax at the lower income levels will bring a greater awareness of responsibility than will heavy taxes on consumption which the taxpayer does not see because they are hidden in the prices he pays.**

4. **In the aggregate, taxes should be somewhat progressive.**

5. **The tax system should be coordinated with the broader objectives of monetary and fiscal policy.**

6. **Federal, state, and local tax policies should be integrated as to principles and objectives.**

Judged by these standards, our present tax system is extremely unsatisfactory; in fact, it is actually damaging. It is a conglomeration of hidden and direct taxes and of conflicting taxing jurisdictions and policies, with no comprehensive economic motive. It is distorted to appease pressure groups and includes uneconomic punitive measures. It is full of needless complexities. It is a paradise for tax lawyers and a source of confusion and despair for the honest, enterprising business man. In fact, it would seem almost as if our tax laws had been written by some fifth columnist for the purpose of making private enterprise unworkable. We in America pretend to believe in the pioneer spirit, but no one would ever suspect it by looking at our tax system.

When the war is over, there must be a thorough reform of our entire tax system. Federal taxes can and should be reduced substantially; and, in the process of reduction, changes can more readily be introduced. At that time, steps can be taken to achieve some degree of coordination and unity of purpose among federal, state, and local taxing agencies. Taxes play too important a role in our total economic life to ignore the adverse consequences of unrelated and inconsistent policies of different taxing jurisdictions.

The following reform measures are needed in federal taxation:

1. **Repeal of the excess profits tax at the earliest possible date after inflationary dangers subside. In the case of most enterprises, the excess profits tax destroys all incentive to do a larger volume of business than in 1939; it appropriates virtually all increase in profits above the level of 1939.**

2. **Coordinate corporation and individual income taxes so as to avoid double taxation and impediments to risk-taking. Preferably, corporation income taxes should be wholly eliminated. Otherwise, the corporation tax rates should be reduced to the lowest effective rate on personal incomes. Full credit should be given to stockholders for all corporate income taxes paid.**

3. **Encourage competition and particularly the formation of new enterprises by allowing new corporations generous tax exemptions for a period of five years. Extend the same principle to unincorporated concerns.**

4. **Encourage risk-taking (and hence job-**

giving) through extending the loss carry-over to six years or more.

5. Provide for averaging incomes over a period of years in order to remove discrimination against those with irregular incomes and those who take risks of loss in business ventures.

6. Rely upon the personal income tax as the main source of revenue, with broad coverage. The reduction in total taxes after the war should favor the elimination of excise taxes before reducing income taxes.

7. Reduce the upper range of personal income tax rates to a maximum of perhaps fifty to sixty per cent so that risk-taking investments will be really attractive. Higher rates are punitive in character, yield small receipts, and throttle risk-taking.

8. Encourage risk-taking by individuals in the higher brackets by making the surtax on incomes of $20,000 a year or more half as much on income in the form of dividends as on income in the form of salaries or interest.

9. Encourage risk-taking by individuals by permitting capital losses to be charged against general income provided the reduction of tax liability in any one year is not more than fifty per cent.

10. Repeal the tax-exempt privilege for all *new* securities issued by all governmental jurisdictions.

11. Eliminate excise taxes which place a disproportionate burden on persons with lower incomes so as to encourage greater consumption and provide an expanded market for our vast industrial capacity.

12. Reform tax administration to simplify forms and procedures, to broaden the scope of enforcement, and to encourage the spirit of fairness.

With such reforms and continuing reappraisal of the tax program as it affects the economic situation, we can look toward taxation as an instrument of constructive influence in giving the fullest encouragement to free enterprise and in attaining continued prosperity.

President, McGraw-Hill Publishing Company, Inc.

PHILIP W SWAIN, EDITOR **POWER** ESTABLISHED IN 1882

Postwar Education

ENGINEERING EDUCATION won't be the same after the war. When the high-pressure techniques of wartime college training are brushed aside, their mark will remain; new teaching tricks have been learned. More important, this warlike interlude gives administrators a providential chance to start postwar programs with a clean slate. What, then, should be done?

While the views expressed are "from the outside looking in," they are based on long and sympathetic observation of engineering schools, administrators, teachers and graduates.

OBJECTIVE: It can be agreed that the aim is to turn out young men fitted to earn a living in industry and well started on the road to distinguished citizenship and well-paid engineering competency.

TEACHER QUALITY: The first requirement of good education is good teachers. Here the schools have a special problem. In general, they offer less money than industry, the difference being offset by the attractions of special vacations (in peace time), academic dignities, an intellectual mode of life, the satisfactions of teaching, plus job security for the professors.

This security may sometimes encourage incompetency and sloth in high places, but the danger can be minimized by great care in selecting and supervising young instructors, so that all who pass to the rank of assistant professor will have clearly proved their knowledge, zeal and teaching skill. Then, too, why don't administrators make it plain that nothing but superlative effectiveness as a teacher can earn the top professorial titles and salaries?

CURRICULUM: On paper, the courses of study should not require radical changes. The same old subjects are still the most important: physics, chemistry, math, mechanics, thermodynamics, hydraulics, drawing, machine design, industrial management, basic power engineering, etc—plus English and economics, of course.

TEACHING SKILL AND METHOD: Teaching effectiveness, on the other hand, needs major improvement. Lectures should be shorter, better and fewer. Text books should be more to the point. There should be more high-powered recitations and conferences. The prewar emphasis on problem work should be expanded. Teachers of machine design should allow more scope for the creative imagination, so that the boys won't be educated out of their native ingenuity.

In such basic subjects as mechanics, hydraulics, kinematics and thermo, broad coverage can well be discarded for a more complete mastery of the handful of universal laws underlying these studies. Well sharpened, these weapons will help the graduate win his future battles with problems now unknown. Exams and tests should be devised to pass the man who really understands the fundamentals and flunk the mere memorizer of formulas. It can be done, and the students should be forewarned and told why.

CONTACT WITH INDUSTRY: The trend toward increased student contact with industry should continue—whether this be by required summer work or the cooperative exchange of students between classroom and job.

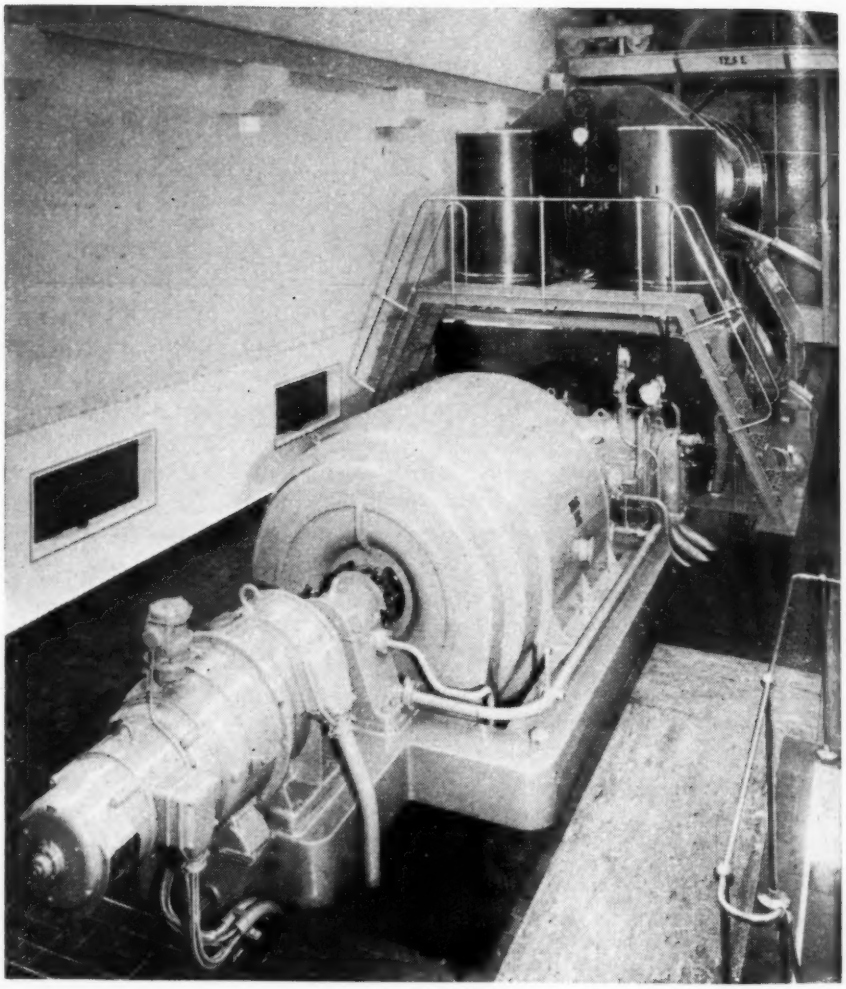
But, how about better field contacts for the teachers, too? Why not experiment with cooperative professorships in such practical subjects as machine design, industrial management and power engineering? Two men could keep one industrial job and one teaching job going full time, swapping positions every twelve months. The result should be inspired teaching, better-informed industrial operations and accelerated professional growth for the men concerned.

IN CONCLUSION: These are ideas for the suggestion box of the many educators who are working and planning for the greater engineering schools of tomorrow—the foundation builders of America's future technology.

Why Bother with Gas Turbines?

Is the gas turbine no more than a fascinating scientific plaything? Or has it a definite place in future power generation? Let's talk common sense about this new and versatile prime mover

By S A TUCKER
Associate Editor



That the gas turbine is a real, practical and workable prime mover has been firmly established. This is a complete 4000-kw power-generating unit installed in an underground tunnel at Neuchatel, Switzerland, for standby service

► MOST OF THE TECHNICAL LITERATURE on gas turbines is concerned with reviewing some 40 years of development, mostly failures, and speculating on a future that would be possible *if* materials were available that would stand up for long periods at 1500 F. While the future of the gas turbine is by no means clear, enough design data, test efficiencies, and actual operating experience is now available to justify a certain amount of wishful speculation provided such crystal gazing is tempered with recognition of gas-cycle limitations.

First, there is one and only one type of gas-turbine power unit on which test data and operating experience are available. This constant-pressure gas-turbine axial-compressor unit (POWER, June, 1939) is schematically pictured in Fig. 1. Ordinary air at room temperature and pressure is compressed to 45-psi gage (or more), heated by direct combustion of oil to 1000 F (or more) and expanded through a turbine. The heated products of combustion can develop more power in the turbine than is required by the compressor so that some net output is available for the generator.

Test Results

On test, the Brown Boveri unit pictured on this page developed 4180 kw net power from 15,660 gross turbine kilowatts, 11,480 kw being used by the compressor (POWER, Feb, 1940). Thermal efficiency was reported as 17.38% corresponding to a heat rate of 19,600 Btu per kwhr and a fuel rate of 1.08 lb fuel oil per kwhr. The turbine developed a blading efficiency of 88.4% and the axial-flow compressor a corresponding efficiency of 84.6%. Temperature at the gas turbine inlet on test was 1025 F.

During the past seven years some 35 such gas-turbine axial-compressor units have been installed in the United States, eight built by Brown Boveri in Switzerland and the remainder by Allis-Chalmers in this country. None of these units was intended primarily for power generation although some byproduct electric power is generated as available from the catalytic petroleum refining process with which they are associated. In addition, at least one 3500-hp exhaust-gas turbine has been built by General Electric for refinery service (*ASME Transactions*, May, 1942).

War conditions interrupted the normal development of gas-turbine power units that might have been expected to follow satisfactory test and operating experience of the first machine. Brown Boveri built one locomotive for the Swiss Federal Railways (POWER, May, 1943) and a number of Velox boilers, Fig. 5, which use the gas-turbine axial-compressor combination as an auxiliary (POWER, Jan, 1943).

Military needs, however, contributed much to the basic knowledge of materials for gas turbines by hastening the development of the airplane gasoline-engine supercharger. One type, of which several million hp have been manufactured, is simply a single-stage gas turbine, driven by gasoline-engine exhaust, coupled to a single-stage centrifugal (or other) compressor and turning at speeds of the order of 20,000 rpm. These turbine blades must stand up under temperatures as high as 1800 F for short periods.

All this experience leads designers to expect that more efficient gas turbines can and will be built when materials become available. Much discussion has been occasioned by the simple, factual statement that it is possible for the efficiency of gas turbines to approach or even exceed that of diesel engines. Fifty years ago the same could have been said of the steam turbine as regards the steam engine, but few could then have outlined the halting steps by which the modern high-efficiency steam station has evolved. Nor can one predict today more than a few near-future chapters of gas-turbine history.

Waiting only on release of critical materials is the gas-turbine locomotive (POWER, Jan, 1944). Two gas-turbine units deliver about 5000 hp to the drivers of an 87-ft locomotive as compared to the two 100-ft elements of the Union Pacific steam-turbine-electric experimental type (POWER, Feb, 1939). Gas-turbine drive would have an expected efficiency of 17% or more as compared with about 12 to 14% for the steam-turbine drive and 6 to 8% for standard reciprocating steam locomotives. Present designs of gas-turbine drive would probably not equal the 23 to 25% efficiency of 3- or 4-unit articulated diesel locomotives, but would have the advantage of containing equal power in a single car (plus fuel tender) and of firing oil of less cost than diesel fuel.

A second "natural" application of gas-turbine drive will be to merchant ships. While many stubborn details remain for marine engineers to work out, a power-plant weight of 20 lb per hp and space occupancy of about 3 cu ft per hp for the gas turbine itself (to which must be added weight and space for reduction-gear and reversing equipment) offers a powerful incentive, plus the probability of lower fuel consumption (0.61 lb per shaft hp) than best modern steam-turbine drive.

Applications in the stationary power field can be outlined only vaguely. Designers agree that gas-turbine power units smaller than 2000 kw have little to offer because of low efficiency. At the other end of the scale the largest unit so far built turns out only 4000 kw, although Brown Boveri have indicated that units up to 10,000 kw are practical for construction in the immediate future using existing materials. Since the number of diesel engines over 2000 kw in stationary power plants is insignificant, the gas turbine can hardly be considered a competitor by engine manufacturers. Conversely, the great bulk of steam-turbine capacity for central stations lies above the 10,000 kw per unit range and it is to be expected that years will elapse before gas-turbine units can hope to offer advantages in this field.

Thus restricted, for the immediate future at least, to a size range of 2000 to 10,000 kw and to oil fuel, the gas turbine must depend on its ability to supply process steam, compressed air or process heat to chemical or industrial plants. Just as the gas-turbine unit is now performing a function in catalytic refining of petroleum that can be equaled by no other prime mover, other applications that can usefully employ the versatile byproduct-producing ability of the gas turbine are to be expected. However, these depend on the development of process requirements neither immediate nor predictable.

Power, Air or Steam

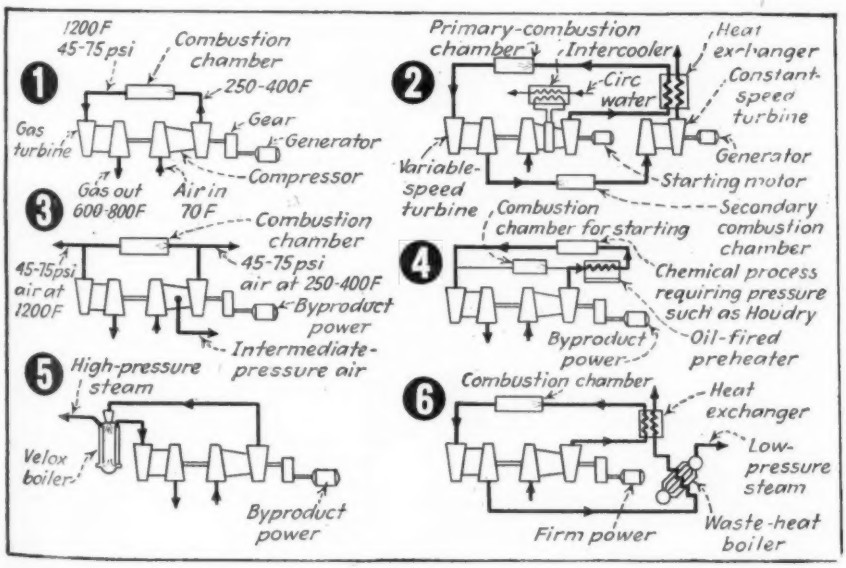
An indication of the pattern of development can be had from six schematic sketches. Fig. 1 is the simplest possible power unit (Neuchatel) without heat exchangers or any auxiliary equipment except a small diesel engine for starting, fuel and lubricating oil pumps. Fig. 2 shows a proposed arrangement for power generation. With heat exchanger and intercooler of reasonable size, an efficiency of 30% (11,400 Btu per kwhr) at the turbine coupling is obtainable.

As indicated in Fig. 3, any proportion of the useful output can be taken as compressed air at any pressure up to that of the gas turbine itself. With no intercooling, air temperature leaving the compressor will range up to perhaps 400 F, to be cooled or not, as required. Any temperature gas up to 1200 F can be had by mixing compressor output with combustion gas. Fig. 4 shows the petroleum refining arrangement now in use in nearly 30 refineries with a combustion chamber for starting only.

Heat-absorbing surface placed in or around the combustion chamber can be used to generate high-pressure steam (with byproduct electric power) as in the original Velox boiler, Fig. 5, or exhaust gas can be utilized to generate low-pressure steam, Fig. 6, just as for diesel waste-heat recovery.

These are but a few elements of possible future gas-turbine cycles. Many combinations and variations are possible. It has also been proposed to combine diesel cylinders with exhaust-gas turbines (POWER, Dec. 1942) but the complexity of mechanical equipment required is a disadvantage. Another scheme contemplates transferring heat from a furnace to a closed air circuit under high pressure to utilize small turbine and compressor parts.

A forward-looking observer would conclude that the future of gas turbines in power generation will probably be based on the *differences* between it and other prime movers rather than on *replacement* of existing machinery that already functions reliably and satisfactorily.



Gas turbines offer the most versatile heat-balance arrangements of any prime mover: (1) basic power unit requires no cooling water or auxiliary apparatus (2) 2-stage power unit aproaches best steam plant efficiency with heat exchanger and intercooler (3) unit can supply compressed air at any pressure up to about 75 psi (4) nearly thirty of these process units are helping make aviation gasoline (5) first practical application of the gas-turbine unit was as an auxiliary to the high-pressure Velox boiler (6) byproduct steam from waste-heat boilers can be had in limited quantities

GIVE FIRE FIGHTERS A CHANCE

Keep hand fire extinguishers ready for instant service with the three-point program of frequent inspection, yearly servicing and immediate refilling after use. It's the only way to provide adequate protection, says W H Easton, Safety Research Institute, Inc

Fig. 1—Before servicing soda-acid or foam extinguisher discharge it to waste

Fig. 2—After removing the head, make sure the gasket is not worn or torn

Fig. 3—Remove acid-bottle cage, suspended in the neck of the soda acid shell

► LET'S BEGIN by listing approved first-aid fire extinguishers: First come the self-generating pressure units that contain soda acid, foam or CO_2; next, the loaded stream and gas cartridge model whose liquid is discharged by pressure from a CO_2 cartridge; third, vaporizing liquid, extinguishing agent, discharged by hand pump or stored air pressure.

Each individual unit demands routine inspection and care peculiar to its type. Provide this needed attention by making some one person responsible for its care, and supply him with the following information as a working guide.

Tour inspection. Make regular periodic inspection and check whether: (1) extinguisher is in its proper place, (2) easy access is obstructed, (3) soda-acid or foam units are exposed to temperatures below 40 F, (4) extinguisher shells have been damaged from falls, blows or freezing.

During war times take the following

Fig. 6—Soda acid. Dissolve powder in warm water and pour into extinguisher

Fig. 7—Soda acid. Replace new acid-bottle cork with stopper from the old one

Fig. 8—Soda acid. Put the new acid bottle and its cage in the extinguisher

precautions each month; quarterly or semiannually is often enough during normal times:

1. Make sure that each extinguisher is charged. Do this by *hefting* all types except carbon dioxide. Weigh the latter and see that its wire-and-lead seal is intact. Recharge suspicious looking extinguishers immediately without fail.

Fig. 4—Wash extinguisher inside and out, draining the water through the hose

Fig. 5—Remove the inner cylinder from foam unit and rinse the case thoroughly

2. Check the last recharging or annual servicing date marked on tag attached to each extinguisher. If this date is more than a year old, or if the tag is missing, service the extinguisher immediately.

3. Examine the extinguisher nozzle. If obstructed, clean it out with a piece of wire. Make sure that nozzles for soda-acid and foam units have not been swapped. (Foam nozzle has larger orifice.)

4. Check pressure gage on stored-pressure vaporizing-liquid extinguishers. If pressure is low bring it up to normal with its air pump or from a service air line. Check liquid level through observation ports; if low, add more liquid.

Saboteurs have been known to fill vaporizing-liquid extinguishers with gasoline. To detect such tampering, discharge a few drops of the liquid into a convenient receptacle and test for odor and flammability. Do this frequently.

Annual servicing and recharging. Annual servicing can be carried on throughout the year by a few specially trained men who also take care of recharging. Power companies usually service extinguishers during the winter months when outside operations are somewhat curtailed.

Supervise inexperienced men carefully when they service extinguishers to insure correct procedure and reassembly of each unit. Never remove so many extinguishers for servicing at one time as to leave any area without some fire protection.

Recharge soda-acid and foam extinguishers annually, if they have not been used in the meantime; the other types require recharging only after use. When replacing parts or recharging a unit, use only material supplied by the extinguisher manufacturer.

Recharging soda-acid units. Examine the extinguisher. If the shell is badly dented or the seam weakened by freezing, do not discharge the extinguisher in the usual manner, but remove the head and empty the contents. Don't solder or repair damaged shells; return them to the manufacturer, or his agent, for reconditioning.

If the extinguisher shell is undamaged and the unit fully charged, empty it by discharging the contents to waste. Then unscrew the head, using a stick thrust through the ring handle as a lever if it is too tight to remove by hand. When servicing several extinguishers at one time, keep each head with its respective tank to prevent interchange. Examine the gasket, and if damaged or badly worn, replace it. Remove the cage containing the acid bottle, putting aside

Fig. 9—Foam unit. Mix *B* chemicals in warm water and pour into extinguisher

Fig. 10—Foam unit. Mix *A* charge in hot water and pour into inner cylinder

Fig. 11—Foam unit. Replace stopple on inner cylinder, return to extinguisher

Fig. 12—Spread vaseline on the threads to facilitate next removal of head

Fig. 13—Screw head in place, making sure that at least four threads engage

Fig. 14—Record the recharging date on the tag attached to the extinguisher

the stopple for later replacement. Rinse the extinguisher shell outside and inside with warm water, draining it through the hose.

Examine the hose strainer inside the shell; if its holes are clogged, open them with a piece of wire. Look over the hose and nozzle and replace if badly worn or damaged. Clean out the nozzle with a smooth-ended wire; measure the opening to guard against interchange with foam nozzle.

Dissolve the dry chemical, supplied in the package of recharging material, in lukewarm water in a clean pail (not in the extinguisher shell), and stir with a clean stick until dissolved. Pour the solution into extinguisher shell, and add enough water to bring to filling mark.

Remove the cork from new acid bottle (supplied as part of the recharging material) and replace it with the stopple from the old bottle. Place the bottle in its cage and lower the cage in the extinguisher neck. Handle acid with great care. If any should spill on the skin, clothing or elsewhere, wash it off immediately with plenty of water.

Recharging foam units. When recharging foam extinguishers discharge the contents to waste. Then remove the head and lift out the inner tank with its stopple. Rinse the shell both outside and inside, draining the water out through the hose.

Dissolve the dry chemical charging material in separate containers, the *A* charge in hot water, and the *B* in lukewarm water, in accordance with instructions on the packages. Pour solution *A* into the inner cylinder and solution *B* into the outer tank, bringing both up to filling marks by adding water. Replace stopple on the inner tank and return it to the main shell.

Before closing up a soda acid or foam extinguisher rub a little vaseline on the shell threads and replace the head, using only hand power. Be sure that the gasket seats snugly against the shell neck and that the head engages at least four screw threads.

Record the date of recharging and the initials of the person doing the work on a tag attached to the extinguisher handle.

Loaded-stream and gas-cartridge units. Since these units operate by gas released from a CO_2 cartridge, the extinguisher should not be discharged for

Fig. 15—Vaporizing liquid unit. Test pump by discharging some of fluid

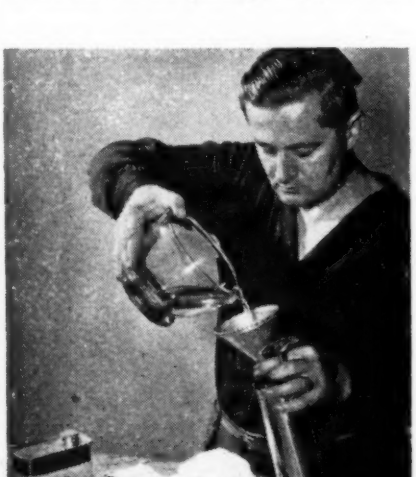


Fig. 16—Pour the discharged liquid back into the extinguisher shell

Fig. 17—Add enough additional fluid to bring level up to half an inch from top

servicing. Remove head and gasket, then inspect strainer and other parts as outlined under the soda-acid unit.

Remove carbon-dioxide cartridge and weigh it on an accurate scale. A loss of ½ ounce or more below the weight stamped on cartridge, indicates leakage and a new one should be installed.

Check the liquid height in the tank and, if necessary, add water to bring it up to the filling line. Replace head, and attach tag with servicing date and initials of the inspector.

When recharging is necessary, rinse the shell with lukewarm water, draining it through the hose. Dissolve the chemical, unless supplied in liquid form, in water, and pour into the shell, adding water to bring up to the filling mark. Add anti-freeze to the water in gas-cartridge extinguishers if they are subjected to temperatures below 40 F. Then insert a new cartridge.

Vaporizing liquid units. Test its action by pumping some of the contents into a clean, dry container. Return the discharged liquid to the extinguisher, adding enough to bring the level up to within ½ inch of the top. Guard against overfilling. Do not lubricate any part of this extinguisher.

Test the stored pressure unit by discharging some of the liquid into a clean, dry container. Release the air pressure before adding liquid to bring it up to the proper level; then replenish the air pressure.

Do not use water in a vaporizing-liquid extinguisher to test its operation, and do not recharge it with commercial carbon tetrachloride, as this may contain impurities that cause corrosion.

Carbon dioxide units. Examine hose and horn for defects and see that the seal on the operating valve is intact. Weigh the unit. If its weight is 10%, or more, below that stamped on the extinguisher, add more CO_2.

Special equipment is required for recharging carbon-dioxide extinguishers (See "How to Recharge CO_2 Cylinders, p 124, Jan, 1944 POWER.). CO_2 may be available locally, or the extinguisher may have to be sent to the manufacturer, his agent, or a gas plant for recharging.

Pump-tank unit. Test by operating the pump several times, discharging the solution back into the extinguisher tank. A drop of thin lubricating oil may be placed on the piston-rod packing. Bring up to the filling mark by adding more water, if necessary.

Protect pump-tank extinguishers exposed to cold weather against freezing by filling them with a solution of 75% crystalline calcium chloride, prepared in accordance with the following table:

Freezing point of solution deg F	*Lb calcium chloride per gal water*
14.4	2.00
— 1.4	2.96
—21.8	4.08

Forecast Points to Increased 1944 Coal Shortage

"THE COAL SHORTAGE is acute now and most factors point to an increasing deficit during 1944" says a summary of coal prospects for 1944 recently released by the Office of War Information, based on data from the Solid Fuels Administration for War and the War Production Board.

OWI said that the United States entered 1944 with a bituminous coal shortage of approximately 25 million tons, according to SFAW figures projected from 1943 records. This official estimate assumes that 1943 requirements exceeded an earlier working estimate of 600 million tons by about five million and that production for December ran more than 12 million tons per week.

The deficit will appear in depleted stockpiles—coal stored by industrial users and retail dealers—which on October 1 amounted to a 45-day supply. From 86 million tons at the beginning of 1943, stockpiles dropped to about 60 million at the year end. This represents only a little more than a month's backlog.

From information supplied by SFAW, the situation may be summarized as follows:

1. The coal shortage is acute now and most factors point to an increasing deficit during 1944.

2. It is not sudden but has been progressive from the beginning of 1943.

3. It is a delayed shortage in that it draws on stockpiles, but consumers feel its effects immediately through the dislocation of distribution.

4. Shipments to Europe to sustain military operations and meet essential needs will increase 1944 demand. This will be necessary even though England is scheduled to supply more coal to Europe this year. American machinery is being sent to England to make possible more English-produced coal for continental operations.

Use Exceeds Production

In a previous OWI report on fuel prospects (June, 1943) war and civilian requirements of bituminous coal for 1943 were announced at 600 million tons. These goals meant production of 20 million tons of bituminous and five million of anthracite more than in 1942. SFAW finds that 1943 consumption was even greater than these hoped-for production goals. Bituminous production through November 27, 1943 totaled 529 million tons. Averaging 12 million tons weekly for the remainder of the year, allowing for holidays, brings the 1943 production slightly above 580 million tons. Corresponding figures on anthracite put 1943 production at not more than 61 million.

Of significance in interpreting projected figures is SFAW's policy of avoiding overstatement of requirements. According to Harold L Ickes, Secretary of the Interior, "Previous estimates have been remarkably accurate but have each time proved to be slightly less than consumption has proved to be. When all the factors that are now operating in consumption and production . . . have made their contribution, the gap between production and consumption may be even greater."

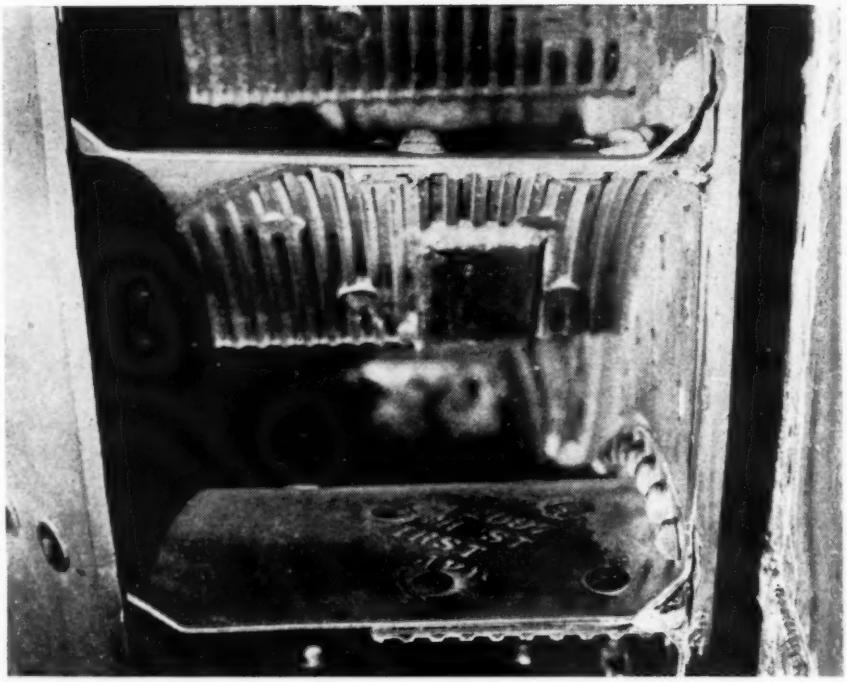
At the rate of coming requirements, coal stocks above ground by March 31, 1944, will represent considerably less than a month's supply for the nation—a dangerously low level. If stocks cannot be replenished in the summer the situation next fall, when the heavy burning season begins, will approach catastrophe.

The prospects of attaining next year's bituminous production goal of 620 million tons (This goal will probably be revised upward in the light of this year's experience.) are summarized as follows by Administrator Ickes: "According to the last estimate, there are 415,000 miners employed in the bituminous mines. In 1941 the average production per miner was 5.2 tons per day. Even under the six-day week the maximum number of days per year miner's average is 280, after deductions have been made for holidays and

(*Continued on page* 158)

Toward Less Draft-Fan Erosion

Stratification and eddies not only cut induced-draft fan capacity but also cause excessive erosion of fan and duct surfaces when flyash is present. Jack Cassie, B F Sturtevant's fan doctor, suggests damper-link change



▶ FLOW CONDITIONS near induced-draft fan inlets are bad enough when designers have to contend only with usual building obstructions. But when wartime restrictions involve changeover from oil to coal and temporary omission of flyash or cinder collectors, fan erosion sometimes becomes a costly and painful maintenance problem. The situation is most acute when flyash is stratified in the gas stream as it passes across the fan wheel.

Stationary fan parts or ductwork can be replaced when convenient, but a worn wheel means danger from physical failure, short wheel life and excessive boiler outage. Furthermore, erosion of ductwork can be minimized by proper internal streamlining with guide sheets (Power, Feb 1942).

If fans operate close to their rated flow, control dampers or vanes are closed only a normal amount and erosion can be expected to stay within reasonable bounds. However, if the dust collector is omitted or for some other reason the fan is oversize or underloaded, dampers or vanes are nearly closed and stratification, accompanied by abnormally high velocities, causes rapid local erosion and short wheel life.

Where such conditions are expected for long periods, several alternates must be considered: (1) running the fan at lower speed (2) substituting a smaller wheel, and (3) artifically increasing the system resistance in such a manner as to avoid turbulence near the fan.

Reduction in speed is most efficient but involves changing motors or motor windings. Substituting a smaller wheel means permanent reduction in fan capacity, delay and boiler outage. Closing damper leaves, as in Fig. 1, to in-

(*Continued on page* 200)

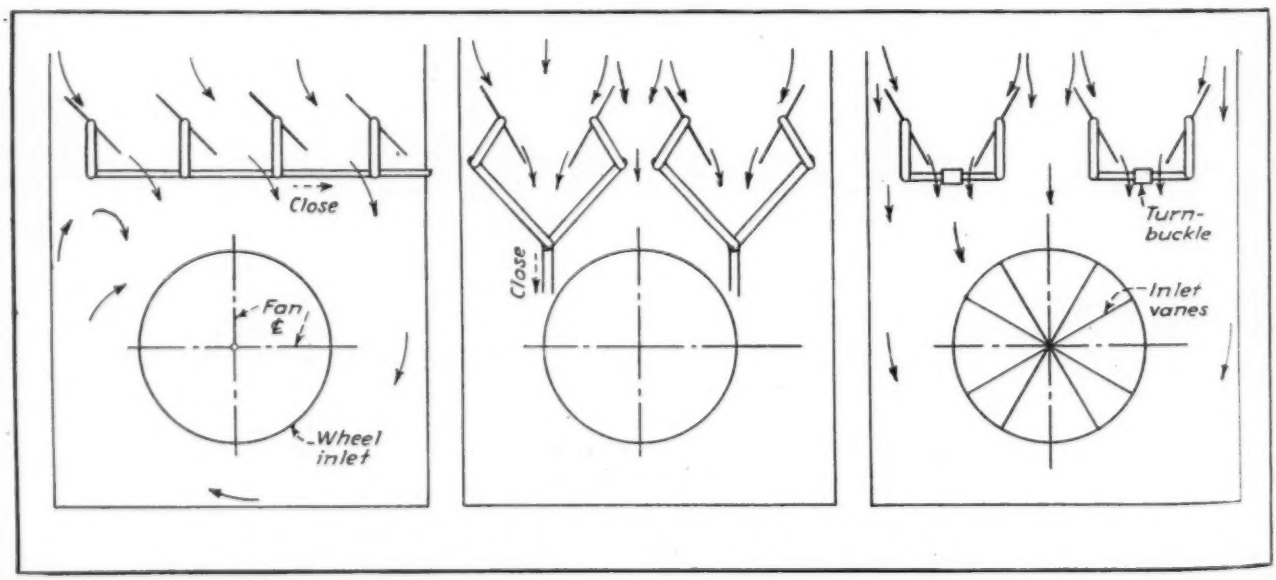


Fig. 1—Stratification results with usual parallel-louver damper arrangement. Fig. 2—Use of opposed linkage keeps ash in flow stream to reduce erosion. Fig. 3—Turnbuckle holds dampers in fixed position for an oversized fan

FEBRUARY, 1944 · P W SWAIN, Editor

POWER HAND BOOK

PART TWO

INDEX

FEEDWATER CHEMISTRY — PAGE 73

FUELS & COMBUSTION — PAGE 76

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HEATING & AIR CONDITIONING — PAGE 92

PART 1 (Dec. 1943, issue) has since been reprinted as a separate pamphlet. This Part 2, concluding the POWER Handbook, brings the total to 56 pages, one of the largest special sections ever published in POWER.

The eleven chapters of Part 1 were:

Weights & Measures
Practical Mathematics
Mathematical Tables
Mechanics & Mechanisms
Mechanics of Materials
Fundamentals of Heat
Steam Tables Simplified
Practical Electricity
Hydraulics & Pumping
Piping, Flow & Tanks
Engineering Economics

As indicated in the December foreword, the Handbook is addressed first of all to the practical engineer without college training. To serve him best, it presents the scientific fundamentals of the everyday power job stripped of all non-essential mathematical and technical frills. Yet the reception of Part 1 has already confirmed the author's expectation that other engineers with more ample technical training would find use for a plain spoken summary of significant first principles and for some of the convenient charts and tables not to be found elsewhere.

In the attempt to "cover" so broad a field so briefly, this presentation can lay no claim to completeness. It cannot in any sense replace the more voluminous standard reference works of the engineer's bookshelf.

For its intended uses the author hopes that this little POWER Handbook will rank high in practical service rendered per page of print and per hour of reader effort.

Phil Swain

Part One POWER HANDBOOK *appeared in the December 1943 issue*

FEEDWATER CHEMISTRY

SOME COMMON ELEMENTS

Symbol	Element	Atomic weight	Valence	Equivalent weight
Al	Aluminum	27.0	3	9.0
Ba	Barium	137.4	2	68.70
Ca	Calcium	40.1	2	20.05
C	Carbon	12.0	Variable	
Fe	Iron (Ferrous)	55.8	2	27.9
Fe	Iron (Ferric)	55.8	3	18.6
H	Hydrogen	1.0	1	1.0
Mg	Magnesium	24.3	2	12.15
N	Nitrogen	14.0	Variable	
K	Potassium	39.1	1	39.1
O	Oxygen	16.0	2	8.00
Na	Sodium	23.0	1	23.0
S	Sulphur	32.0	Variable	

SOME COMMON ACID RADICALS

Formula	Name	Radical weight	Valence	Equivalent weight
HCO_3	Bicarbonate	61.0	1	61.0
CO_3	Carbonate	60.0	2	30.0
Cl	Chloride	35.46	1	35.46
NO_3	Nitrate	62.0	1	62.0
OH	Hydrate	17.0	1	17.0
PO_4	Phosphate	95.00	3	31.66
SO_3	Sulphite	80.00	2	40.00
SO_4	Sulphate	96.06	2	48.03

SOME COMMON ACIDS

Formula	Name	Mol weight	Equivalent weight
H_2CO_3	Carbonic acid	62.0	31.00
HCl	Hydrochloric acid	36.46	36.46
H_3PO_4	Phosphoric acid	98.00	32.67
H_2SO_4	Sulphuric acid	98.1	49.05
H_2SO_3	Sulphurous acid	82.1	41.05

POWER-PLANT CHEMISTRY chiefly concerns boiler feedwater and fuels and combustion, page 76. This article outlines the ABC's of chemistry, with applications to feed water, as space permits.

Atoms, Elements, Compounds

Unlike a compound, an element is a basic substance, one that cannot be subdivided into other substances. The smallest piece of any element is its atom. If you could smash the atom you would have no element left, nothing but the common particles of electricity of which the atoms of all elements are built.

A molecule is two or more atoms chemically (electrically) bound together. A compound is a substance, other than an element, containing only one kind of molecule. Thus hydrogen and oxygen are elements. Two atoms of hydrogen combine with one atom of oxygen to form one molecule of water, written in the shorthand of chemistry as H_2O.

Note that elements, like compounds, have molecules, but the atoms in the molecule of an element are all alike. Thus, the molecule of oxygen gas has two oxygen atoms, so its symbol is O_2.

The somewhat fanciful *chemical dominoes* here used to picture chemical formulas and reactions are a reliable guide to the various combinations. The table above (Common Elements) lists the principal elements found in power-plant water chemistry.

Some of these are pictured as the *cations* (pronounced cat-eye-uns) of Fig. 1. When any compound is dissolved in water it *ionizes;* that is, its molecules split into two or more kinds of *ions.* Sometimes an ion is a single atom. Sometimes it is a group of atoms called a *radical.*

Every ion carries one or more electrical charges, all plus or all minus. If charges are plus, the ion is called a cation. If charges are minus, the ion is an *anion* (pronounced an-eye-un). In Fig. 1, any cation can combine with any anion to form a molecule of a compound. Where each has the same number of charges (that is, the same *valence*) one cation combines with one anion, as HCl (hydrochloric acid) or $AlPO_4$ (aluminum phosphate). In these compounds, note that each plus charge on a cation pairs with a minus charge on an anion. "Opposites attract."

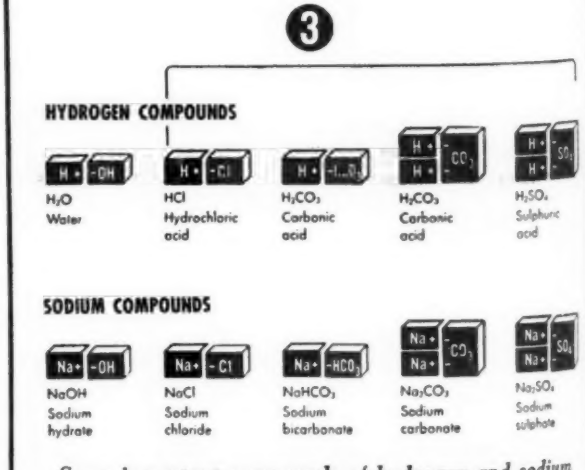
Where the cation has a different number of charges from the anion, pile up the model atoms (dominoes) side by side until finally the pluses and minuses balance. In Fig. 2 this balance is reached for aluminum and sulphate ions when two atoms of Al are alongside three ions of the SO_4 radical. Therefore, the correct formula for aluminum sulphate is $Al_2(SO_4)_3$.

At the top of Fig. 2, one H cation balances one OH anion to form HOH, water, more commonly written H_2O. With hydrogen and the SO_4 sulphate radical, the balance of pluses and minuses is obtained with two of H and one of SO_4, making H_2SO_4, sulphuric acid.

As already indicated, the *valence* of any cation or anion is the number of charges (electrical "hooks") it carries. Most ions have only a single valence, but iron has two. In the so-called *ferric* compounds of iron the valence of iron is 3, but in *ferrous* compounds the valence is 2. Thus, *ferric* sulphate is $Fe_2(SO_4)_3$, six plus charges balancing six minus charges. *Ferrous* sulphate is $FeSO_4$, two plus charges balancing two minus. This is clearer if you make your own sketches like those in Fig. 2.

Metals, Bases, Acids, Salts

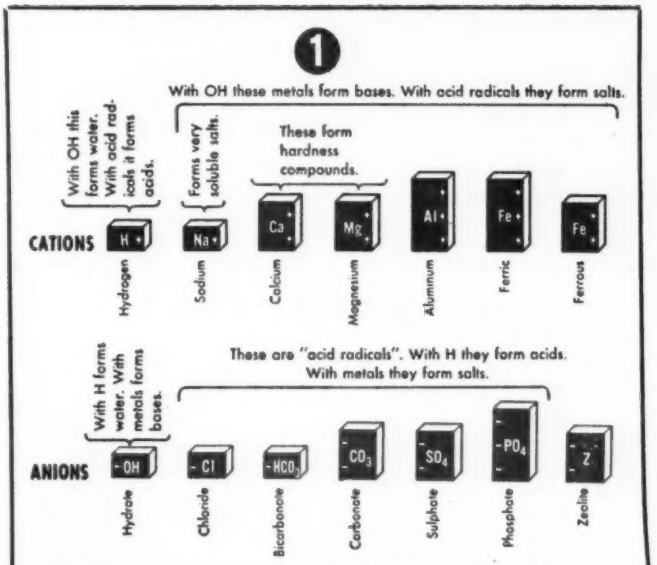
Except hydrogen, all cations in Fig. 1 are metals. Combined with the OH (called *hydrate* or *hydroxide*) anion, any of these metals forms a *base,* a substance that reacts strongly with an acid and turns litmus paper blue. Acids turn it red. You might say that a base is the



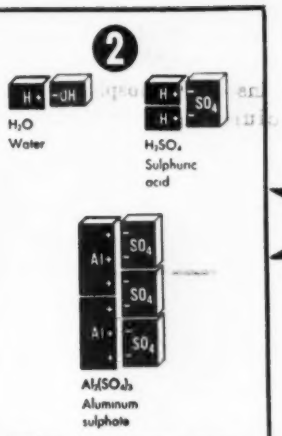
Some important compounds of hydrogen and sodium

IONIC ANALYSIS OF UNTREATED WATER

	Ppm	Epm
Calcium (Ca.)...	62	3.10
Magnesium (Mg)	31	2.54
Sodium (Na)....	38	1.64
Iron oxide & alumina	4	0.22
Silica (SiO_2)....	18	0.60
Bicarbonate (HCO_3)	250	4.10
Sulphate (SO_4)..	138	2.87
Chloride (Cl)....	11	0.31
Volatile and organic	56	...
Total solids by evap.	480	...
Suspended matter	238	...
Free CO_2	16	0.73



Principal cations and anions of boiler-water chemistry



When ions form a compound, the number of pluses must equal the number of minuses (This number is listed as valence in tables.)

opposite of an acid. A good example is the strong base NaOH, sodium hydroxide, that is caustic soda.

Except for OH, all the anions shown in Fig. 1 are called *acid radicals*. When any one of these combines with hydrogen the result is an acid. Thus hydrogen combines with chlorine to form HCl, hydrochloric acid, and with SO_4 to form H_2SO_4, sulphuric acid.

Finally, if any metallic cation combines with any acid-radical anion, the result is a *salt*. In addition to *common salt* (NaCl, or sodium chloride) we have $CaSO_4$ (calcium sulphate), Na_2CO_3 (sodium carbonate or *soda ash*) and many others.

A salt can be formed by the direct action of an acid on metal or of an acid on a base. If the base caustic soda (NaOH) is mixed with hydrochloric acid (HCl), the resulting transformation is shown by the chemical equation: NaOH + HCl = NaCl + HOH. Note how the radicals swap places. The NaCl is common salt. The HOH is merely another way of writing H_2O, water.

Except water, all compounds of hydrogen in Fig. 3 are acids, that is, combinations of H with acid radicals, as already explained. The second row of Fig. 3, and both rows of Fig. 4, picture salts made by combining the metals—sodium, calcium and magnesium—with the various acid radicals.

Just as is true of common table salt, all ordinary sodium compounds are extremely soluble, hence cannot cause scale. Note that several of the sodium salts, particularly the hydrate (NaOH, or caustic soda), carbonate (Na_2CO_3) and various phosphates (See table, page 74.) are widely used to soften water. Also calcium hydrate, $Ca(OH)_2$, called lime or milk of lime, is used in lime-and-soda water softeners.

Water-Softening Equations

Commonest scale-forming compounds in feedwater are the bicarbonates, carbonates and sulphates of calcium and magnesium. With calcium bicarbonate, merely heating the water to around 200 F drives off CO_2 as a gas, thereby reducing the $Ca(HCO_3)_2$ to $CaCO_3$, calcium carbonate. The formula is:

$Ca(HCO_3)_2$ + heat → $CaCO_3$ + H_2O + CO_2

Note the balance of atoms on both sides of equation: 1 atom of Ca, 2 of H, 2 of C, 6 of O.

Because the calcium carbonate is insoluble, it precipitates and settles in the softener as a soft chalky mud. In the same way, heat can convert magnesium bicarbonate into magnesium carbonate, but this carbonate does not precipitate successfully because it is somewhat soluble. Therefore, magnesium bicarbonate is often treated with lime, as shown later.

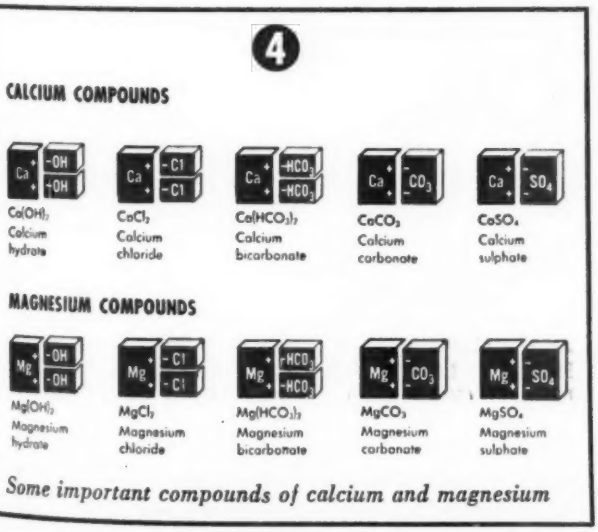
Untreated waters containing no hardness except carbonates and bicarbonates form a sludge or soft scale in the boiler. On the other hand, the sulphates of magnesium and calcium form hard scale, and even a little sulphate cements the carbonate into a shell of hard scale.

In the lime-and-soda softener, which is usually operated hot to speed the reactions, the soda ash (sodium carbonate) treats the calcium sulphate by the reaction pictured in Fig. 5. Precipitation of the insoluble calcium carbonate is indicated by the down-pointing arrow.

Fig. 5 also shows how hydrated lime converts soluble calcium bicarbonate into insoluble carbonate, which then precipitates.

Precipitates in the softener are removed by settling and filtration before water goes to the boiler. In all the chemical reactions shown, note that every atom on the left side of an equation shows up on the right because atoms are indestructible.

At boiler pressures above 250 psi, the lime-soda treatment should be replaced or supplemented by sodium phosphate, in one of various forms, because the sodium phosphates do not break



Some important compounds of calcium and magnesium

down at high boiler temperatures and are able to precipitate insoluble phosphates of calcium and magnesium. These come down in the boiler as a fine sludge that can be removed by blowdown. The phosphate is often fed directly to the boiler.

Phosphates sometimes include those listed in the table on this page. The trisodium phosphate precipitates calcium carbonate as tricalcium phosphate by this reaction:

$$3\,CaCO_3 + 2\,Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 3Na_2CO_3.$$

Zeolite Softeners

Unique among softening agents are the so-called *zeolites*, also known as greensands and base-exchange silicates. They are used as sand in beds like filter beds, and do not dissolve in the water. In fact, the sand-like zeolite may be used over and over

USEFUL CHEMICAL DATA

Reprinted by permission from "Feed Water Chemistry"—Cochrane Corp.

Substance	*Formula*	*Weight of molecule or radical*	*Equivalent weight*
Aluminum	Al	27.0	9.00
Aluminum hydrate	$Al(OH)_3$	78.0	26.00
Alumina	Al_2O_3	102.0	17.00
Sodium aluminate	$Na_2Al_2O_4$	164.0	27.33
Barium	Ba	137.4	68.70
Barium carbonate	$BaCO_3$	197.4	98.70
Barium chloride	$BaCl_2 \cdot 2H_2O$	244.3	122.15
Barium sulphate	$BaSO_4$	233.4	116.70
Calcium	Ca	40.1	20.05
Calcium bicarbonate	$Ca(HCO_3)_2$	162.1	81.05
Calcium carbonate	$CaCO_3$	100.1	50.05
Calcium chloride	$CaCl_2$	111.0	55.50
Calcium hydrate (pure)	$Ca(OH)_2$	74.1	37.05
Calcium hydrate (90%)	$Ca(OH)_2$	.....	41.10
Calcium oxide (pure)	CaO	56.1	28.05
Calcium oxide (90%)	CaO	.....	31.17
Calc sulphate (anhyd)	$CaSO_4$	136.2	68.08
Calc sulphate (gypsum)	$CaSO_4 \cdot 2H_2O$	172.2	86.1
Calcium nitrate	$Ca(NO_3)_2$	164.1	82.05
Calcium phosphate	$Ca_3(PO_4)_2$	310.3	51.71
Iron (ferrous)	Fe	55.8	27.9
Iron (ferric)	Fe	55.8	18.60
Ferric oxide	Fe_2O_3	159.6	26.60
Iron oxide and alumina	R_2O_3	109.0	18.20
Ferrous sulphate	$FeSO_4 \cdot 7H_2O$	278.0	139.00
Magnesium	Mg	24.3	12.15
Magnesium oxide	MgO	40.3	20.15
Magnesium bicarbonate	$Mg(HCO_3)_2$	146.3	73.15
Magnesium carbonate	$MgCO_3$	84.3	42.15
Magnesium chloride	$MgCl_2$	95.2	47.60
Magnesium hydrate	$Mg(OH)_2$	58.3	29.15
Magnesium nitrate	$Mg(NO_3)_2$	148.3	74.15
Magnesium phosphate	$Mg_3(PO_4)_2$	263.0	43.83
Magnesium sulphate	$MgSO_4$	120.4	60.20
Manganese chloride (ous)	$MnCl_2$	125.9	62.95
Manganese hydrate (ous)	$Mn(OH)_2$	89.0	44.50
Potassium	K	39.1	39.10
Potassium iodide	KI	166.0	166.0
Silver chloride	AgCl	143.3	143.30
Silver nitrate	$AgNO_3$	169.9	169.90
Silica	SiO_2	60.1	30.05
Sodium	Na	23.0	23.00
Sodium bicarbonate	$NaHCO_3$	84.0	84.00
Sodium carbonate	Na_2CO_3	106.0	53.00
Sodium chloride	NaCl	58.5	58.50
Sodium hydrate	NaOH	40.0	40.00
Sodium nitrate	$NaNO_3$	85.0	85.00
Sodium sulphate	Na_2SO_4	142.0	71.00
Sodium thiosulphate	$Na_2S_2O_3$	158.1	79.5
Sodium tetrathionate	$Na_2S_4O_6$	270.2	135.10

ACID RADICALS

Bicarbonate	HCO_3	61.0	61.00
Carbonate	CO_3	60.0	30.00
Carbon dioxide	CO_2	44.0	22.00
Chloride	Cl	35.46	35.46
Iodide	I	126.9	126.90
Nitrate	NO_3	62.0	62.00
Hydrate	OH	17.0	17.00
Phosphate	PO_4	95.0	31.66
Phosphorous oxide	P_2O_5	142.0	23.67
Sulphate	SO_4	96.06	48.03

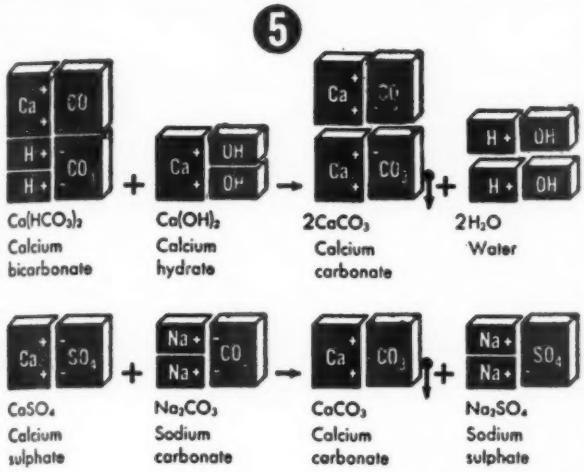
ACIDS

Hydrogen	H	1.0	1.00
Acetic acid	$HC_2H_3O_2$	60.0	60.00
Carbonic acid	H_2CO_3	62.0	31.00
Hydrochloric acid	HCl	36.46	36.46
Phosphoric acid	H_3PO_4	98.0	32.67
Sulphuric acid	H_2SO_4	98.1	49.05
Manganous acid	H_2MnO_3	104.9	52.45

ALUMS AND PHOSPHATES

Note: In formulas, H_2O indicates water of crystallization. The expression (18.7% P_2O_5) means that one pound of given phosphate contains equivalent of 0.1875 lb. of phosphorus pentoxide.

Substance	*Formula*	*Weight of molecule or radical*	*Equivalent weight*
Aluminum sulphate (crystal)	$Al_2(SO_4)_3 \cdot 18H_2O$	666.4	111.06
Aluminum sulphate (anhydrous)	$Al_2(SO_4)_3$	342.1	57.01
Ammonium alum	$Al_2(SO_4)_3(NH_4)_2SO_4 \cdot 24H_2O$	906.6	151.10
Potassium alum	$Al_2(SO_4)_2K_2SO_4 \cdot 24H_2O$	948.8	158.13
Trisodium phosphate	$Na_3PO_4 \cdot 12H_2O$ (18.7% P_2O_5)	380.2	126.73
Trisodium phosphate (anhydrous)	Na_3PO_4 (43.4% P_2O_5)	164.0	54.66
Disodium phosphate	$Na_2HPO_4 \cdot 12H_2O$ (19.8% P_2O_5)	358.2	119.40
Disodium phosphate (anhydrous)	Na_2HPO_4 (50.0% P_2O_5)	142.0	47.33
Monosodium phosphate	$NaH_2PO_4 \cdot H_2O$ (51.4% P_2O_5)	138.1	46.03
Monosodium phosphate (anhydrous)	NaH_2PO_4 (59.1% P_2O_5)	120.1	40.03
Metaphosphate (Hagan)	$NaPO_3$ (69.5% P_2O_5)	102.0	34.00



Typical reactions in lime-soda softener: above, lime & calc bicarbonate; below, soda ash & calc sulphate

for years, but must be regenerated at intervals as it loses its softening power. In its active form (so-called *sodium zeolite*) the ordinary zeolite is chemically bound to sodium as Na_2Z.

When water carrying calcium or magnesium hardness is passed through the filter bed a double exchange or swap takes place. The calcium or magnesium moves over to the zeolite, while sodium from the zeolite attaches itself to the acid radicals. The resulting sodium salts left in the water are highly soluble and non-scale-forming. The equation is:

$$Ca(HCO_3)_2 + Na_2Z \rightarrow CaZ + 2NaHCO_3$$

As fast as the sodium zeolite grains are converted to calcium zeolite they become inactive. Eventually the whole process must be reversed to *regenerate* the zeolite. It is soaked in a strong brine of common salt which *pumps* sodium back into the zeolite and removes the calcium and magnesium as magnesium chloride and calcium chloride. These are washed to waste. The regenerated sodium zeolite is then ready for another tour of softening duty.

Note that every form of treatment described leaves sodium salts in the water. These cannot cause scale, but may increase priming at heavy concentrations.

Water Analysis

Many years ago chemists acquired the unfortunate habit of reporting water analyses in imaginary *combined* forms, saying that the water tested contained so much sodium carbonate, so much calcium bicarbonate, so much magnesium chloride, etc. The uninitiated, including law courts, have thereby been led to believe that the water actually contained the listed compounds in the listed amounts, or approximately so. *The fact is that no chemist can determine which compounds or how much of each is in any water if it contains more than a single compound.* The operations of chemical analysis determine only the *ions* present, not how they are hooked up. Therefore the only scientific way to report an analysis is in the ionic form, as in the table on page 73. Here the ppm column gives the parts per million of each ion.

If two careful chemists analyze the same water they can both agree substantially on the ionic analyses. Then if each follows his private, arbitrary set of rules as to *how* the ions are combined in imaginary compounds, each will have a different *combined* analysis. The moral is that power engineers should insist on having all analyses reported in ionic form.

Tables in this article give the *equivalent weight* of each ion and compound listed. This is the weight of the atom, radical or molecule divided by its valence. The equivalent weight can be used to get the epm (equivalent per million) column of the ionic analysis. Divide ppm by the equivalent weight to get epm. Thus, the equivalent weight of calcium is 20, so the epm of calcium in the sample ionic analysis is $62 \div 20 = 3.10$.

How to Interpret The Analysis

Using the epm so figured, "Feedwater Chemistry" of Cochrane Corp gives the following rules for interpreting an ionic analysis:

Add the epm of calcium and the epm of magnesium to get A.

Add the epm of bicarbonate and the epm of carbonate to get B.

Rule 1—If *A* is greater than *B*, permanent hardness is proportional to the excess.

Rule 2—If *A* equals *B*, all the hardness is temporary, with no excess sodium carbonate. This water produces a carbonate scale that is more easily removable than if the water contained some permanent hardness.

Rule 3—If *A* is less than *B*, an excess of sodium carbonate is proportional to the difference. Such a water commonly produces sludge and not boiler scale.

Rule 4—If the water shows any hydrogen radical it generally indicates free acid or acid properties.

Rule 5—Total hardness, expressed as equivalent calcium carbonate, is merely *A* times 50.

If the foregoing rules are applied to the given analysis, we get $A = 5.64$ and $B = 4.1$, indicating that the water contains moderate permanent hardness and that the total hardness $= 5.64 \times 50 = 282$ ppm.

For lime-soda treatment in hot-process softeners the following rules give the lime-and-soda ash required in pounds per million pounds of water. The lime is assumed to be 90% calcium hydrate.

Lime = (epm of HCO_3 + epm of Mg) $\times 41$

Soda ash = (epm of Ca + epm of Mg + 0.47 − epm of HCO_3) $\times 53.3$

Then, for given analysis:

Lime $= (4.1 + 2.54) \times 41 = 272$ lb per million lb water

Soda ash $= (3.1 + 2.54 + 0.47 - 4.1) \times 53.3 = (2.01) \times 53 = 107$ lb per million lb water

Because of frequent water variations, such computations can only approximate the day-to-day lime-and-soda requirements. Precise control must be maintained by routine testing of the treated water and the boiler water, using test equipment and formulas obtainable from manufacturers of water-treating chemicals and equipment.

The acidity or alkalinity of a water is commonly rated on a scientific scale called *pH* or *hydrogen-ion concentration*. It is common to refer to water or some process solution as having a *pH* value of 4.3 or 9.5, etc, which can be changed by the addition of alkaline or acid substances. The *pH* value is easily determined by test with simple kits. A neutral sample (neither acid nor alkaline) will read 7.0. Numbers falling below 7 represent rapidly increasing acidity.

Conclusion

This attempt to set down some useful principles of chemistry and its water-treating application in four pages should close with a warning that the subject in its entirety is so complex that even expert chemists find many problems difficult. It follows that the power engineer who is not a chemical expert must seek specialist advice whenever his water problems are something out of the ordinary.

Meanwhile, the chemical ABC's here explained will find useful application to the study of fuels and combustion (next article).

FUELS & COMBUSTION

FEEDWATER CHEMISTRY, pages 72 to 75, explains atoms, molecules, atomic weights, molecular weights, valences, etc—also how atoms balance on the two sides of a chemical equation. In addition, combustion chemistry involves matters of heat release and gas laws.

Combustion is the combination of oxygen and the combustible substance with rapid evolution of heat (and generally resulting temperatures above 1000 F).

Burning Carbon

Most often the oxygen is supplied in air, which is 21% oxygen by volume and 23% by weight, the remainder being nitrogen and other inert gases.

Suppose pure carbon is completely burned with pure oxygen. The reaction is:

$2\,C + 2\,O_2 = 2\,CO_2$
24 parts + 64 parts = 88 parts
1 lb + 2.67 lb = 3.67 lb

In the foregoing, atomic weight of carbon is 12 and of oxygen 16. "Parts" in the second line are merely the weights of molecules present. The oxygen molecule, like that of other gases that are elements, contains *two* atoms.

To get pound weights in third line, divide each number in second line by 24.

Since 1 lb of carbon, completely burned to CO_2 (carbon-dioxide gas), gives off 14,500 Btu, the formula might be written: 1 lb carbon + 2.67 lb oxygen = 3.67 lb carbon dioxide + 14,500 Btu.

In practice an excess of air must generally be supplied. Then the products of combustion will contain the *excess* oxygen unchanged, plus all the nitrogen, (since nitrogen does not react chemically in combustion).

Burning Carbon to CO

Under certain conditions, part of the carbon in fuel burns incompletely to the poison gas CO (carbon monoxide) releasing only about one third the heat it would if burned to CO_2. Formulas are:

$2\,C + O_2 = 2\,CO$
24 parts + 32 parts = 56 parts
1 lb + 1.33 lb = 2.33 lb
+ 4350 Btu

This 2.33 lb of CO can later be burned to give up the rest of the heat originally in the carbon, thus:

$2\,CO + O_2 = 2\,CO_2$
56 parts + 32 parts = 88 parts
2.33 lb + 1.33 lb = 3.67 lb
+ 10,150 Btu

Hydrogen

Hydrogen burns with oxygen to form water, H_2O, thus:

$2\,H_2 + O_2 = 2\,H_2O$
4 parts + 32 parts = 36 parts
1 lb + 8 lb = 9 lb
+ 61,000 Btu

In the foregoing, note three things: (1) hydrogen and oxygen molecules have two atoms, (2) heat value of hydrogen is very high, (3) one lb hydrogen consumes 8 lb oxygen and produces 9 lb water.

Sulphur

Sulphur in fuel is mainly a nuisance, but it does contribute some heat, thus:

$S + O_2 = SO_2$
32 parts + 32 parts = 64 parts
1 lb + 1 lb = 2 lb
+ 4,000 Btu

The sulphur dioxide produced combines with cold water to form the highly corrosive sulphurous acid, H_2SO_3, which eats away metal in air preheaters, economizers and stacks, if temperature falls below dewpoint of the flue gas.

Actual Fuels

While any solid fuel may be analyzed into its elements for an "ultimate" analysis, the composition is more com-

PROPERTIES OF COMBUSTION PRODUCTS AND COMMON COMBUSTIBLES

Substance	Formula	Molecular weight	At 14.7 psi abs and 60F: Weight lb per cu ft	At 14.7 psi abs and 60F: Volume, cu ft per lb	Nature: Gas or solid	Nature: Combustible	Heating value, Btu: Per lb	Heating value, Btu: Per cu ft at 14.7 psi abs & 60 F	Heating value, Btu: Per mol
Carbon	C	12			S	C	14,500		174,000
Hydrogen	H_2	2	.00528	189.5	G	C	61,000	322	122,000
Sulphur	S	32			S	C	4,000		128,000
Carbon monoxide	CO	28	.0739	13.54	G	C	4,350	321	122,000
Methane	CH_4	16	.0422	23.69	G	C	23,900	1008	382,000
Ethylene	C_2H_4	28	.0739	13.54	G	C	21,600	1596	605,000
Ethane	C_2H_6	30	.0792	12.63	G	C	22,300	1766	669,000
Oxygen	O_2	32	.0844	11.84	G	No			
Nitrogen	N_2	28	.0739	13.54	G	No			
Air		29*	.0765	13.07		No			
Carbon dioxide	CO_2	44	.1161	8.61	G	No			
Water	H_2O	18				No			

* *Molecular weight* of air is weighted average of molecular weights of oxygen and nitrogen.

Values in this table differ slightly from those in other reference books, but the difference is generally less than 1%. For internal consistency, this table is based first on the generally accepted heat values, rounded as indicated. From these, and the listed molecular weights, all other data were computed on the assumption that all gases tabulated are perfect and that the volume of one mol is 379 cu ft at 60 F and 14.7 psi

Weight of one mol, in lb, equals molecular weight

WEIGHT AND VOLUME OF ONE MOL

Substance	Formula	Molecular weight	Weight of 1 mol, lb	Volume of 1 mol, mol unit of volume (not cuft)	State at room temperature
Carbon dioxide	CO_2	44	44	1	Gas
Carbon monoxide	CO	28	28	1	Gas
Hydrogen	H_2	2	2	1	Gas
Oxygen	O_2	32	32	1	Gas
Nitrogen	N_2	28	28	1	Gas
Methane	CH_4	16	16	1	Gas
Ethylene	C_2H_4	28	28	1	Gas
Ethane	C_2H_6	30	30	1	Gas
Air		29	29	1	Gas
Carbon	C	12	12	*	Solid
Sulphur	S	32	32	*	Solid
Water	H_2O	18	18	**	Liquid

* Don't attempt to use for solids the *volume* rule for one mol of gas. Solid volumes run very much less and usually are not considered.

** At high temperature, H_2O is superheated steam, in which condition one mol is one volume approximately. This does not hold for combustion products at room temperature. Before an orsat analysis H_2O condenses out, so H_2O volume for gas-analysis purposes is taken as zero.

monly reported on the *proximate* basis (not *approximate*) like this, for coal:

	Percents by weight
Moisture	2.8
Volatile	35.2
Fixed carbon	54.0
Ash	8.0
Total	100.0
Sulphur	1.7
Btu	13,540

The *volatile* matter is the tarry material driven off, after the moisture, when the coal is heated in an air-tight retort. Volatile consists mainly of compounds of carbon and hydrogen called *hydrocarbons*. Because of this hydrogen, the volatile always has a higher heat value than carbon. Thus, coals with high percentages of volatile matter have relatively high heating values (if ash and moisture content is normal).

Fixed carbon is the uncombined carbon that remains (with the ash) as coke when coal is heated in a closed retort away from air that could support combustion.

If this fixed carbon is then burned away, the residue is ash. In the sample analysis, the constituents total 100% without counting the sulphur, considered as part of the ash for purposes of proximate analysis.

Heat value, Btu, is found by burning a sample of the coal in a bomb calorimeter.

Following is a typical *ultimate analysis* of coal as required for certain scientific purposes:

	Percents by weight
Ash	10.49
Sulphur	1.20
Carbon	71.98
Hydrogen	6.47
Nitrogen	1.16
Oxygen	8.70
Total	100.00

Here carbon includes both fixed carbon and that in the volatile—also all hydrogen and oxygen in moisture are reported.

Heat value can be checked fairly closely from the ultimate analysis, using data already given. First note that only a fraction of all the hydrogen in a fuel is available to burn and produce heat. Much of the hydrogen is unburnable because it is already combined with oxygen to form the moisture in the coal.

It is commonly assumed that all the oxygen shown in the ultimate analysis is so combined. Therefore one eighth the weight of oxygen in the fuel is deducted from the total hydrogen to get the so-called *free* or burnable hydrogen.

In the foregoing analysis, total hydrogen = 0.0647 lb. Bound hydrogen = 0.087 ÷ 8 = 0.0109 lb. *Free* hydrogen = 0.0647 − 0.0109 = 0.0538 lb
Computed heat value:

C, 0.7198 × 14,500 = 10,437 Btu
H, 0.0538 × 61,000 = 3282 Btu
S, 0.012 × 4000 = 48 Btu

Then 10,437 + 3282 + 48 = 13,767 Btu
Total should be close to the Btu shown by calorimeter.

Combustion Weights

It is good practice to work one combustion problem the hard way before using the shortcuts on page 80.
Problem: Figure air supplied and combustion products if the foregoing fuel is burned with 40% excess air.

We have already seen that 1 lb hydrogen burns with 8 lb oxygen to make 9 lb water, also that 1 lb carbon burns with 2.67 lb oxygen to make 3.67 lb of CO_2, also that 1 lb sulphur burns with 1 lb oxygen to make 2 lb of SO_2. Then theoretical oxygen requirements are:

for H, .0538 × 8	= 0.430
for C, 0.7198 × 2.67	= 1.922 lb.
for S, 0.012 × 1	= 0.012 lb.
Total	2.364 lb.
Plus 40%	0.946
Actual oxygen	3.310 lb.

Air is 23% oxygen by weight, so weight air actually supplied is 3.31 ÷ 0.23 = 14.4 lb.

Since no weight can be destroyed, the products of combustion must be 1 lb coal plus the 14.4 lb air = 15.4 lb total. However the 0.105 lb ash will go through the grate, so that the stack gases cannot weigh more than 15.5 − 0.1 = 15.4 lb per lb of fuel, and will actually weigh a little less than this because some good coal always goes through the grate.

If we take 15.4 lb as the actual total weight of flue gas per lb of coal burned, weight of *dry* gas is 15.4 lb minus the weight of water in the flue gas. Since all hydrogen in coal is originally water, or burns to water, water in flue gas is nine times the *total* hydrogen (not *free* hydro-

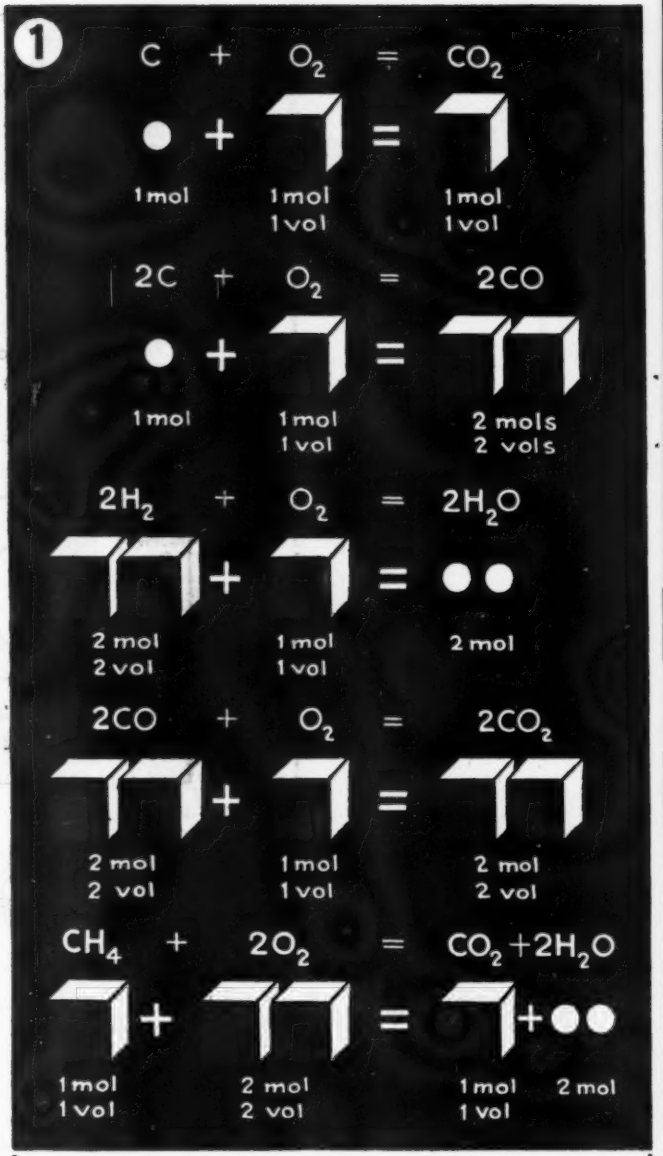


Fig. 1—Mol and vol relations for following reactions:
Carbon burning to carbon dioxide
Carbon burning to carbon monoxide
Hydrogen burning to water
Carbon monoxide burning to carbon dioxide
Methane (CH_4) burning to carbon dioxide and water

In these formulas note that the number of mols of any substance is the same as the number of molecules. If the substance is a gas it is also true that the number of volumes is the same as the number of mols. Thus, two volumes of carbon monoxide, plus one volume of oxygen, gives two volumes of carbon dioxide

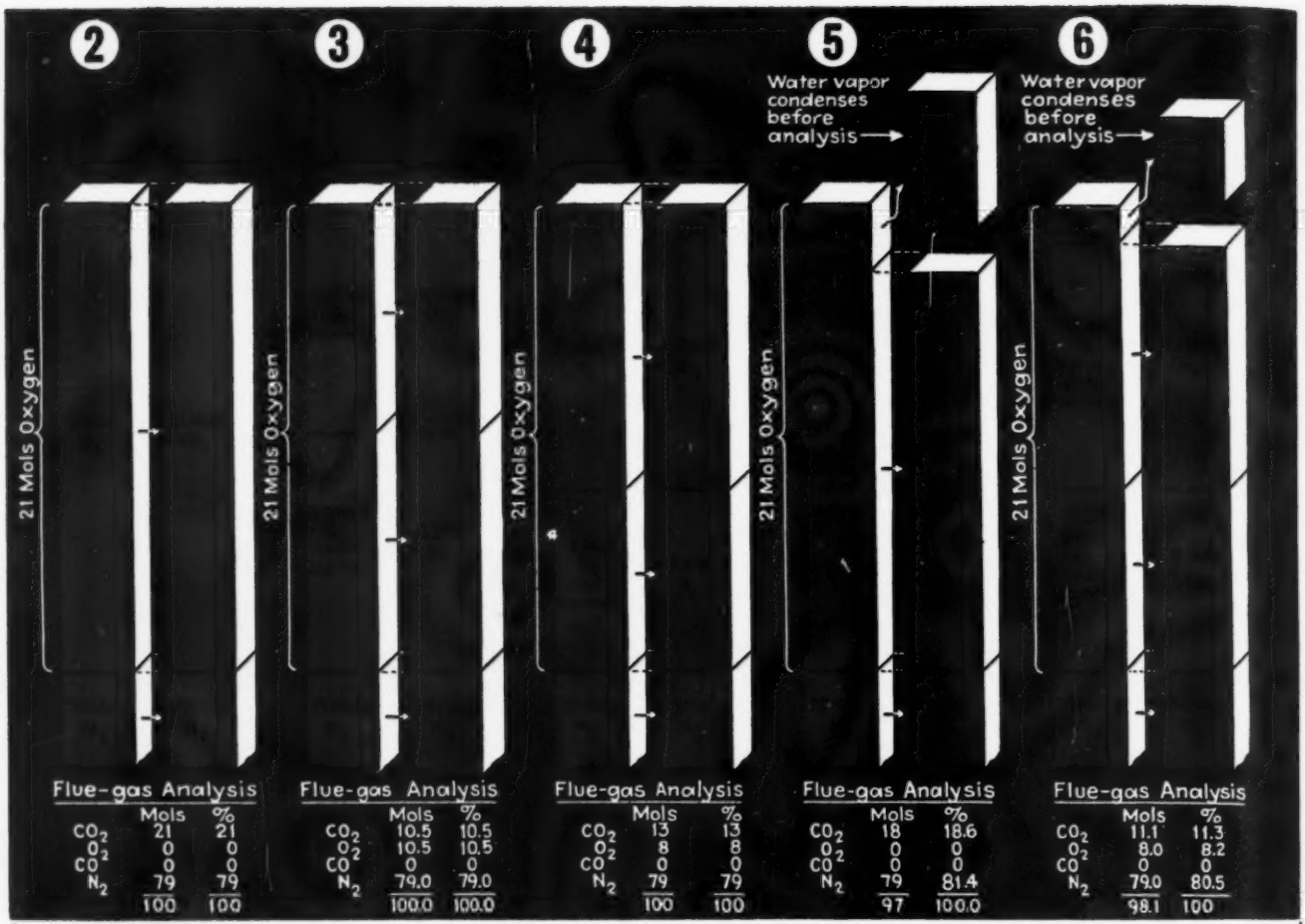


Fig. 2—When fuel containing no hydrogen burns completely, without excess air, flue gas contains 21% CO_2 and 79% N_2. Fig. 3—When fuel of Fig. 2 burns with 100% excess air, analysis shows 10.5% CO_2 and 10.5% O_2. Note that 10.5 ÷ 10.5 = 1 = 100%. Fig. 4—With fuel of Fig. 2, if CO_2 in flue gas is 13% then O_2 will be 21 — 13 = 8%. Excess air is 8 ÷ 13 = 0.62 = 62%

Fig. 5—Fuel has so much hydrogen that 3/21 of oxygen combines with it to form water. Dividing mols by 0.97 gives percentages. No oxygen remains in flue gas, so 18.6% CO_2 corresponds to zero excess air. Fig. 6—Fuel of Fig. 5 burned with 62% excess air, as in Fig. 4, gives less CO_2 because of H_2. Here 8 mols of unburned O_2 divided by 13 mols of burned O_2 gives 0.62 or 62%

CONSOLIDATED COMBUSTION DATA

Gives required combustion air and products for common combustibles burned with theoretical air requirements. Air and products are given in mols, cu ft and lb (see right-hand column) for 1 mol, 1 cu ft and 1 lb of fuel

AIR REQUIRED AND COMBUSTION PRODUCTS

Fuel	For 1 mol of fuel					For 1 cu ft of fuel					For 1 pound of fuel					
	Air		Other products (than N_2)			Air		Other products (than N_2)			Air		Other products (than N_2)			
	O_2	N_2	CO_2	H_2O	SO_2	O_2	N_2	CO_2	HO_2	SO_2	O_2	N_2	CO_2	H_2O	SO_2	
	1.0	3.76	1.0								.0833	.313	.0833			Mols
C	379	1425	379								31.6	118.8	31.6			Cu ft
	32.0	105	44.0								2.67	8.78	3.67			Pounds
	0.5	1.88		1.0		.00132	.00496		.00264		.250	.940		0.5		Mols
H_2**	189.5	712		379*		0.5	1.88		1.0*		94.8	356		189.5*		Cu ft
	16.0	52.6		18		.0422	.139		.0475		8.0	26.3		9.0		Pounds
	1.0	3.76			1.0						.0312	.1176			.0312	Mols
S	379	1425			379						11.84	44.6			11.84	Cu ft
	32.0	105			64						1.0	3.29			2.0	Pounds
	0.5	1.88	1.0			.00132	.00496	.00264			.179	.0672	.0357			Mols
CO	189.5	712	379			0.5	1.88	1.0			6.77	25.4	13.53			Cu ft
	16.0	52.6	44.0			.0422	.139	.116			.571	1.88	1.57			Pounds
	2.0	7.52	1.0	2.0		.00528	.0198	.00264	.00528		.125	.470	.0625	.125		Mols
CH_4	758	2850	379	758*		2.0	7.52	1.0	2.0*		47.4	178	23.7	47.4*		Cu ft
	64.0	210	44.0	36.0		.169	.556	.116	.0950		4.0	13.17	2.75	2.25		Pounds
	2.5	9.40	2.0	1.0		.0066	.0248	.00528	.00264		.0962	.362	.0769	.0385		Mols
C_2H_2	947	3560	758*	379*		2.5	9.40	2.0	1.0*		36.4	137	29.15	14.58*		Cu ft
	80.0	263	88.0	18.0		.211	.694	.232	.0475		3.08	10.13	3.38	.692		Pounds
	3.0	11.29	2.0	2.0		.00792	.0298	.00528	.00528		.1071	.403	.0714	.0714		Mols
C_2H_4	1137	4280	758	758*		3.0	11.29	2.0	2.0*		40.6	153	27.1	27.1*		Cu ft
	96.0	316	88.0	36.0		.253	.834	.232	.0950		3.43	11.29	3.14	1.286		Pounds
	3.5	13.17	2.0	3.0		.00923	.0347	.00528	.0079		.1167	.439	.0667	.10		Mols
C_3H_8	1326	4990	758	1137*		3.5	13.17	2.0	3.0*		44.2	166.3	25.3	37.9*		Cu ft
	112.0	369	88.0	54.0		.296	.972	.232	.1425		3.73	12.29	2.93	1.8		Pounds

* *The volumes shown for H_2O apply only where the combustion products are at such high temperature that all the H_2O is a gas.*
** *Varying assumptions for molecular weight introduce a slight inconsistency in the values of air and combustion products from the burning of hydrogen. True molecular weight of hydrogen is 2.02 but the approximate value of 2 is used in figuring the air and combustion products.*

gen) in coal, $9 \times 0.0647 = 0.58$ lb. Then the dry gas is $15.4 - 0.58 = 14.8$ lb.

Next figure the products of combustion in detail:

$SO_2 = 0.012 \times 2 = 0.024$ lb.
H_2O (just figured) $= 0.58$ lb.
$CO_2 = 0.7198 \times 3.67 = 2.64$ lb.

Weight unburned oxygen (already figured) $= 0.946$ lb. Weight nitrogen = weight air supplied — oxygen supplied $= 14.4 - 3.31 = 11.1$ lb.

We then get the following analysis of the dry flue gas, *by weight*:

	Lb	*%*
SO_2	0.02	0.1
CO_2	2.64	17.9
O_2	0.95	6.5
N_2	11.10	75.5
Total	14.71	100.0

Ordinarily a gas analysis would be reported in per cents by *weight* instead of by *volume*. This conversion can be made in various ways. One is to multiply the lb of each gas by the volume of 1 lb from the first table on properties, page 76. This gives analysis by cu ft, which can then be converted into percent.

How to Use Mols

A more modern method of combustion computation uses the so-called *mol*, and is particularly convenient when gases are involved.

Fig. 11 gives the volume of one lb of any gas at any pressure and temperature within the limits of the chart, which has enough range for most combustion problems. This chart combines three gas laws that may be briefly stated as follows:

A—Volume varies directly as the absolute temperature

B—Volume varies inversely as the absolute pressure

C—Comparing equal volumes of different gases at the same pressure and temperature, the weights in pounds are proportional to the molecular weights.

In the foregoing, absolute pressure (in psi) is gage + 14.7 and abs temperature is 460 + F temperature.

These three laws are combined in the following formula:

Cu ft per pound $= 10.7 \times T \div (P \times mw)$, where T is absolute temperature, P is absolute pressure, psi, and mw is molecular weight (See first table on properties, page 76.

Law *C* above is very important in gas chemistry, and a great labor saver. Consider such a quantity of any gas that the weight in pounds is the same number as the molecular weight. Call this *weight* of gas 1 mol. Now it is a startling fact that the volume of this mol is the same regardless of the gas used.

Mol is 379 Cu Ft

At 60 F and 14.7 psi abs the volume of one mol of any true gas is always 379 cu ft. This then would be true of 32 lb of oxygen, or 28 lb of nitrogen, or 44 lb of carbon dioxide, etc.

To make this simpler, call this standard volume of the mol simply "1 vol," instead of 379 cu ft.

The law just stated is based on the fact that a given volume, at a given pressure and temperature, holds just so many gas molecules, no matter what the gas is. It follows that the weight of the given volume of gas is in exact proportion to the molecular weight. The volume of the mol is such that the weight in pounds is exactly the same as the molecular weight.

All this information ties together in the following arrangement of the formula for burning carbon:

	$C + O_2 = CO_2$
(in mw)	$12 + 32 = 44$
(in lb)	$12 + 32 = 44$
(in mols)	$1 + 1 = 1$
(in vol)	$? + 1 = 1$

Note how the number of mols comes out the same as the number of molecules. Note also that (for a gas, but not for a solid) the volume (in standard mol units) is the same as the number of molecules.

From this we see that an unknown volume of carbon combining with one volume

EXAMPLE OF COMBUSTION OF COAL

Given complete analysis of coal and flue gas. To determine (per lb of coal) theoretical air, actual air, dry flue gas, moisture in flue gas—also per cent excess air and per cent loss from incomplete combustion.

(1) Ult Analysis of Coal (as fired), % by Weight

Ash	10.49
Sulphur	1.20
Hydrogen	6.47
Carbon	71.98
Nitrogen	1.16
Oxygen	8.70
	100.00%

Btu per lb. 13,800

(2) Flue-Gas Analysis, Percent by Volume

CO_2	10.2
CO	0.6
O_2	9.2
N_2	80.0
	100.00%

(3) Figuring Mols of Carbon and Nitrogen in Flue Gas

Flue Gas	%	Mols Gas	Mols C	Mols N_2
CO_2	10.2	10.2	10.2	....
CO	0.6	0.6	0.6	....
O_2	9.2	9.2	....	....
N_2	80.0	80.0	....	80.0
Total mols	....	100.0	10.8	80.0

(4) Weight carbon burned $= 10.8 \times 12 = 129.6$ lb
(5) Weight coal burned $= 129.6 \div 0.7198 = 180.0$ lb
(6) Mols air supplied $= 80.0 \div 0.79 = 101.3$
(7) Weight air supplied $= 101.3 \times 29 = 2938$ lb
(8) Ratio air to coal $= 2938 \div 180.0 = 16.32$ lb air per lb coal
(9) Moisture produced per lb coal $= 0.0647 \times 9 = 0.58$ lb
(10) Dry flue gas per lb coal = coal + air − ash − moisture $= 1 + 16.32 - 0.1049 - 0.58 = 16.64$ lb

CO Loss

(11) Fraction of carbon burning to CO $= 0.6 \div (10.2 + 0.6) = 0.0555$
(12) Weight of carbon burning to CO $= 0.0555 \times 0.7198 = 0.040$
(13) Heat loss from CO $= 0.040 \times 10160 = 406$ Btu
(14) Percent heat loss from CO $= 100 \times 406 \div 13{,}800 = 2.94\%$
(15) Theoretical Air per Pound Coal

	Lb of Combustible	Lb O_2 Required per lb Comb.	Lb O_2 Required
Carbon	0.7198	2.67	1.922
Hydrogen	0.0647	8.00	0.518
Sulphur	0.012	1.00	0.012
Total			2.452
Less oxygen in the coal			0.087
Net oxygen needed			2.365 lb × 4.32 = 10.22 lb air

(16) Excess air $= 16.32 - 10.22 = 6.10$ lb
(17) Per cent excess air $= 6.10 \div 10.22 = 59.7\%$

EXAMPLE OF COMBUSTION OF NATURAL GAS

Given volumetric analysis of a natural gas. To determine the volumetric analysis of the flue gas if the fuel is burned with 40% excess air (by volume).

(1) Gas Analysis by Volume, %

CO	0.60
H_2	1.62
CH_4	94.30
C_2H_4	0.15
H_2S	0.25
O_2	0.40
CO_2	0.85
N_2	1.83
Total	100.00

(2) Oxygen, Combustion Products for 100 Mols of Fuel

Gas	Mols	Mols O_2 Needed	Mols Produced CO_2	Mols Produced H_2O	Mols Produced SO_2
CO	0.60	0.30	0.60	.....	.....
H_2	1.62	0.81	.....	1.62	.....
CH_4	94.30	188.60	94.30	188.60	.....
C_2H_4	0.15	0.45	0.30	0.30	.....
H_2S	0.25	0.37	.....	0.25	0.25
CO_2	0.85	.....	0.85	.....	.....
Total	.....	190.53	96.05	190.77	0.25
Minus O_2 in fuel	.....	0.40	.....	.....	.....
	.....	190.13	96.05	190.77	0.25

(3) Figuring nitrogen in flue gas

N_2 required for 190.13 mols O_2 $= 190.13 \times 3.76 = 714.9$ mols
40% excess N_2 (by volume) $= 0.4 \times 714.9 = 286.0$
N_2 in fuel $= 1.8$
N_2 in flue gas $= 1002.7$ mols

(4) Unburned O_2 in flue gas $= 0.40 \times 190.13 = 76.0$ mols
(5) Volumetric Gas Analysis (H_2O Disappears)

Gas	Mols	% by Vol.
CO_2	96.1	8.2
O_2	76.0	6.5
SO_2	0.2	0.0
N_2	1002.7	85.3
Total	1175.0	100.0

of oxygen produces one volume of carbon dioxide.

Rule: In any chemical equation take the coefficient of each molecule as the number of mols. If the element or compound is a gas this same number may also represent the volume.

Fig. 1 shows how this rule works out for common combustion reactions. Notice that the volumes are not indicated in the case of H_2O, because water is a liquid or vapor rather than a true gas under most conditions considered.

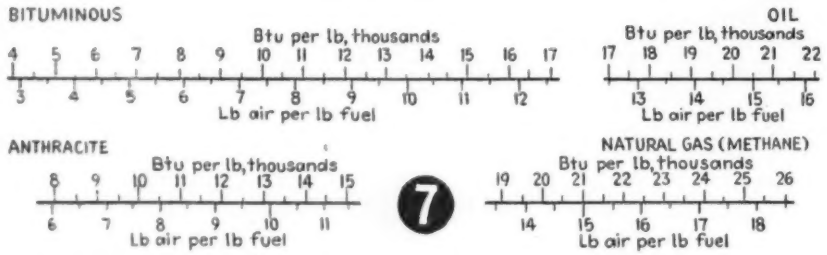
The volume relations in Fig. 1, together with Fig. 2, 3, 4, 5 and 6, make clear the meaning of the CO_2 percentage in flue gas.

In all cases start with 100 cu ft of air and see what happens to it. Remember that nitrogen volumes go through unchanged.

Three things may happen to various parts of the oxygen. The excess or unburned part of the oxygen goes through unchanged. Of the oxygen burned, part may burn completely with C to produce the same volume of CO_2. Another part may burn incompletely to produce twice its volume of CO.

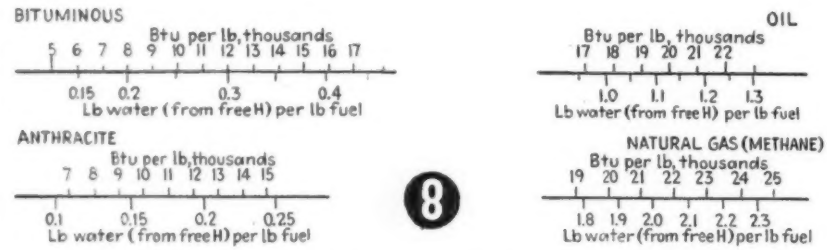
Some of the oxygen may burn with the free hydrogen

SHORT-CUT SOLUTIONS OF COMBUSTION PROBLEMS


BITUMINOUS
Btu per lb, thousands
4 5 6 7 8 9 10 11 12 13 14 15 16 17
3 4 5 6 7 8 9 10 11 12
Lb air per lb fuel
OIL
Btu per lb, thousands
17 18 19 20 21 22
13 14 15 16
Lb air per lb fuel
ANTHRACITE
Btu per lb, thousands
8 9 10 11 12 13 14 15
6 7 8 9 10 11
Lb air per lb fuel
NATURAL GAS (METHANE)
Btu per lb, thousands
19 20 21 22 23 24 25 26
14 15 16 17 18
Lb air per lb fuel

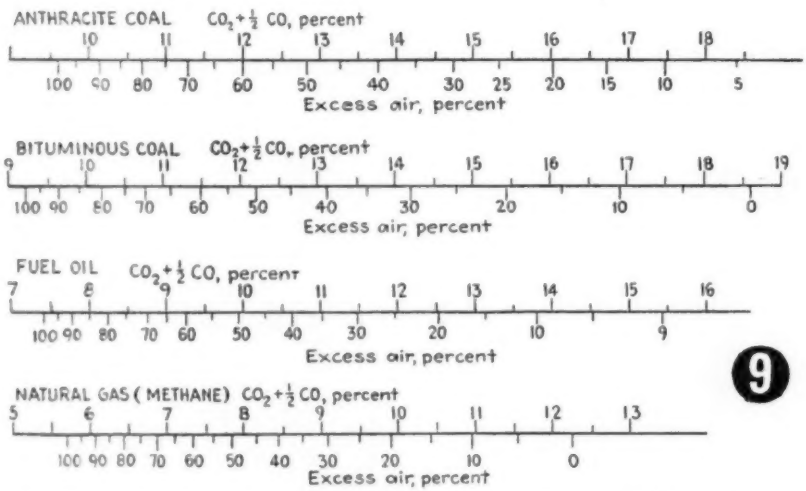
7

THEORETICAL AIR: Lb air required to burn one lb of fuel


BITUMINOUS
Btu per lb, thousands
5 6 7 8 9 10 11 12 13 14 15 16 17
0.15 0.2 0.3 0.4
Lb water (from free H) per lb fuel
OIL
Btu per lb, thousands
17 18 19 20 21 22
1.0 1.1 1.2 1.3
Lb water (from free H) per lb fuel
ANTHRACITE
Btu per lb, thousands
7 8 9 10 11 12 13 14 15
0.1 0.15 0.2 0.25
Lb water (from free H) per lb fuel
NATURAL GAS (METHANE)
Btu per lb, thousands
19 20 21 22 23 24 25
1.8 1.9 2.0 2.1 2.2 2.3
Lb water (from free H) per lb fuel

8

WATER FROM HYDROGEN: Lb produced by burning free hydrogen in one lb fuel


ANTHRACITE COAL $CO_2+\frac{1}{2}CO$, percent
10 11 12 13 14 15 16 17 18
100 90 80 70 60 50 40 30 25 20 15 10 5
Excess air, percent
BITUMINOUS COAL $CO_2+\frac{1}{2}CO$, percent
9 10 11 12 13 14 15 16 17 18 19
100 90 80 70 60 50 40 30 20 10 0
Excess air, percent
FUEL OIL $CO_2+\frac{1}{2}CO$, percent
7 8 9 10 11 12 13 14 15 16
100 90 80 70 60 50 40 30 20 10 9
Excess air, percent
NATURAL GAS (METHANE) $CO_2+\frac{1}{2}CO$, percent
5 6 7 8 9 10 11 12 13
100 90 80 70 60 50 40 30 20 10 0
Excess air, percent

9

EXCESS AIR: From flue-gas analysis add percent CO_2 to half CO (if any). With this sum enter scale marked with class of fuel and read % excess air

Steps in Using Fig. 7, 8, 9, 10

A—Get theoretical air from Fig. 7
B—Get water in flue gas from Fig. 8, plus water in fuel
C—Get excess air percentage from Fig. 9
D—From *A* and *C* get actual weight of air supplied
E—Deduct known or estimated weight of ashes per pound of fuel from 1 lb to get fuel "going up the stack"
F—Add *D* and *E* to get total weight of flue gas
G—Subtract *B* from *F* to get weight of dry flue gas
H—Sensible heat loss in dry flue gas, in Btu per lb fuel = $G \times 0.25 \times$ difference between flue and room temperature
I—Moisture loss in flue gas, in Btu per lb fuel = $B \times (1000 + \frac{1}{2}$ flue temperature, F)
J—Get incomplete-combustion percentage loss from Fig. 10

Illustrative Data

Bituminous Coal, 13,800 Btu per lb
Moisture in coal, 5%
Room temperature 80F, flue gas 520 F
Flue-gas analysis, per cent: CO_2 10.2, CO 0.6, O_2 9.2
Boiler efficiency, by test, 74.4%
Actual ashes (rough estimate) 0.2 lb per lb coal

Solution

A—Theoretical air = 10.3 lb
B—Water in flue gas = 0.35 + 0.05 = 0.40
C—Excess air = 75%
D—Actual air = 10.3 × 1.75 = 18.0 lb
E—Coal "up stack" = 1—0.2 = 0.8 lb
F—Weight flue gas = 18.0 + 0.8 = 18.8 lb
G—Weight dry flue gas = 18.8 — 0.4 = 18.4 lb
H—Sensible heat loss in dry flue gas = 18.4 × 0.25 × (520 × 80) = 2020 Btu
I—Moisture loss = 0.40 × (1000 + 260) = 504 Btu, say 500 Btu
J—Incomplete-combustion loss = 3.2%
(The boiler test shows total losses of 25.6%, which must be equal to losses *H*, *I*, *J*, plus the *unaccounted losses*. These cover ashpit loss, radiation, etc, plus all errors and discrepancies.

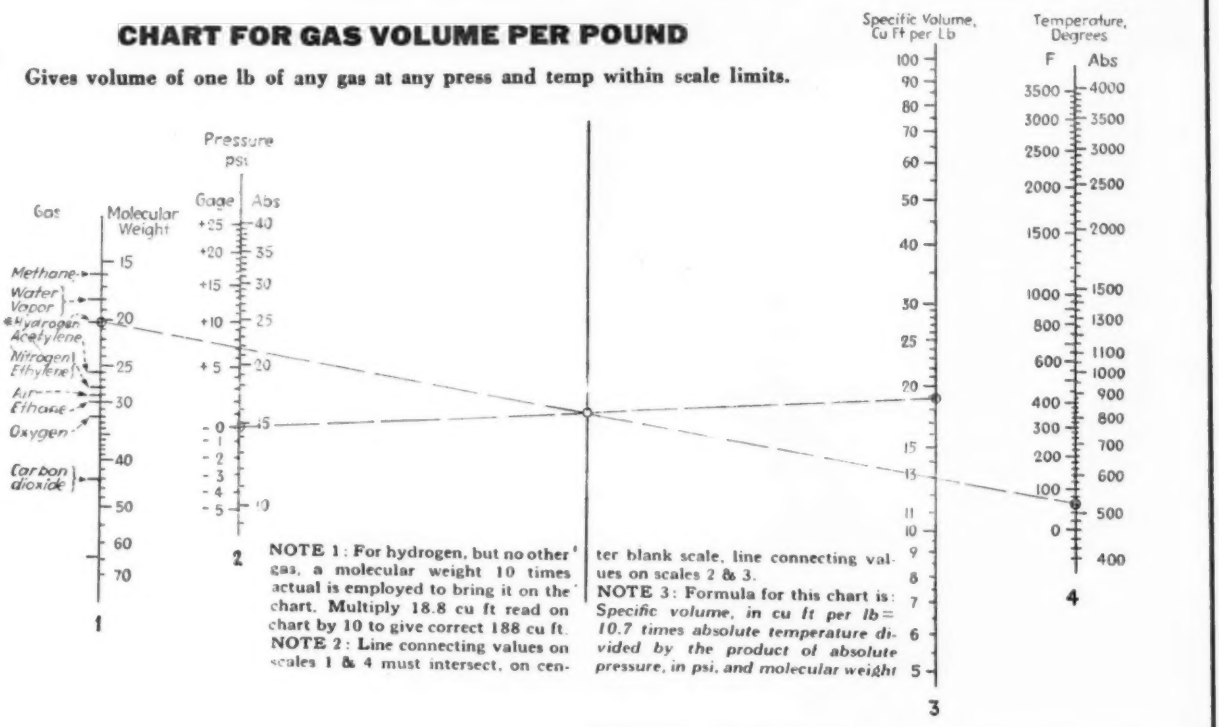
Heat Balance

In the following heat balance, numbers not in parenthesis are taken directly from the given data and from *H*, *I*, *J*. Remembering that any item in the per cent column is to the corresponding item in the Btu column as 100 is to 13,800, complete the heat balance by simple proportion. Slide rule is most convenient.

	Btu	%
Sensible heat, dry gas..	2020	(14.6)
Moisture loss	500	(3.6)
Incomplete combustion loss	(440)	3.2
Unaccounted losses ...	(570)	(4.2)
Total losses	(3530)	(25.6)
Useful heat	(10270)	(74.4)
	13800	100.0

11 CHART FOR GAS VOLUME PER POUND

Gives volume of one lb of any gas at any press and temp within scale limits.



NOTE 1: For hydrogen, but no other gas, a molecular weight 10 times actual is employed to bring it on the chart. Multiply 18.8 cu ft read on chart by 10 to give correct 188 cu ft.

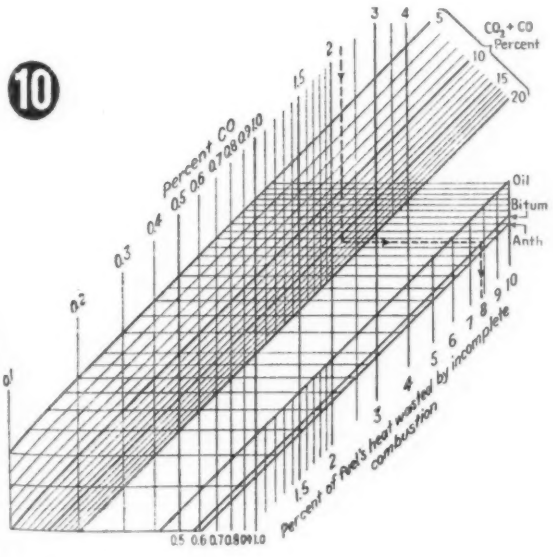
NOTE 2: Line connecting values on scales 1 & 4 must intersect, on center blank scale, line connecting values on scales 2 & 3.

NOTE 3: Formula for this chart is: *Specific volume, in cu ft per lb = 10.7 times absolute temperature divided by the product of absolute pressure, in psi, and molecular weight*

CHART FOR LOSS FROM INCOMPLETE COMBUSTION

(CHARTS IN THIS ARTICLE DESIGNED BY P W SWAIN)

10



INCOMPLETE-COMBUSTION LOSS: From flue-gas analysis get percent of CO and CO_2. From chart read fraction of fuel's heat lost by incomplete combustion of carbon to CO. Dotted line shows solution for bituminous coal in case where CO is 2.2%, CO_2 is 13.8% and CO + CO_2 is 16%. Chart here shows 7.8% of fuel's heat lost by incomplete combustion. Usually such loss is much smaller

in the fuel to produce H_2O, which condenses and disappears as volume before analysis, thus involving a net shrinkage of gas volume.

Where the fuel contains no combustible except carbon, Fig. 2 and 3 suggest a shortcut in figuring the percentage of excess air.

Problem: Assuming (roughly) that anthracite coal contains no combustible other than carbon, what is the excess air if flue gas analyzes 12% CO_2 by volume?

Oxygen, representing excess air = 21 — 12 = 9%. Excess air = 9 ÷ 12 = 0.75 = 75%.

This method is slightly in error for anthracite coal and coke, more so for bituminous coal, which has more volatile.

Shortcut Methods

For everyday computations with coal or oil, use Fig. 7, 8, 9 and 10. As explained on page 80, the method is rapid, easy and accurate enough for all practical purposes.

Here are practical comments on the various losses in boiler heat balances, such as that worked out on page 80.

First, the moisture loss depends on the coal. It can't be reduced without changing the coal. Usually it is small.

The most important loss is that of sensible heat in the dry gases. This can be reduced by cutting down excess air, (indicated by higher CO_2) also by reducing the flue temperature by tight baffles and clean boiler tubes.

If unaccounted losses are excessively high, look for a heavy loss of carbon through the grate, also for errors.

For a more detailed scientific study, the coal table, page 79, works out a coal-consumption problem on a strictly chemical basis, using the mol system. The natural-gas table, page 79, does the same for one sample of natural gas. While most natural gases are mainly methane (CH_4) the other variables present are enough to make any single chart only roughly approximate for natural gases in general.

For a given natural gas the supplying utility should be able to provide a curve giving the percentage flue loss corresponding to any flue temperature and CO_2 percentage.

STEAM GENERATION

THE MOST IMPORTANT boiler computations, and those easiest to make, pertain to output, input and over-all efficiency. Before reading the following it will be helpful, but not essential, to review "Steam Tables Simplified," pages 78-81, in Power Handbook, Part 1. This was first published in December POWER, 1943, and has since been separately reprinted.

All sample problems in this article will be based on the abbreviated steam tables in "Steam Tables Simplified," but for practical use the engineer should have the complete standard steam tables contained in "Thermodynamic Properties of Steam" by Keenan and Keyes, published by John Wiley and Sons, Inc., New York City. If the abbreviated tables are used the pressure or temperature required will often fall inconveniently between tabulated values. Except for certain cases with superheated steam, the work of interpolating generally can be avoided by using the long tables.

Table number references in the following refer both to "Steam Tables Simplified" and to Keenan and Keyes.

The modern terminology will be used. That is, instead of the "heat in" the various forms of water, we shall refer to the "enthalpy."

Heat Required

For most practical boiler-room purposes the heat absorbed by water in going from one state to another may be taken as simply the enthalpy of the final state minus that of the initial state. (Note: For steam at high pressures this assumption may introduce a small error.)

Problem: How much heat must a boiler supply to convert one pound of feedwater at 210 F into dry saturated steam at 185 psi gage.

From Table 1, enthalpy of feedwater at 210 F is 178.1 Btu per lb. From Table 2 enthalpy of steam at 200 psi abs (185 psi gage + 15) is 1198.4 Btu. Then heat supplied is 1198.4 — 178.1 = 1020.3 Btu per pound.

Problem: How much heat is required to convert one pound of feedwater at 360 F to superheated steam at 1200 psi abs and 800 F?

Here enthalpy of feedwater is 332.2 (Table 1). From Table 3, enthalpy of steam at 1200 psi and 800 F is 1379.3 Btu. Then heat supplied will be 1379.3 — 332.2 = 1047.1 Btu per lb.

Boiler Efficiency

Unless otherwise specified, the "efficiency" of a boiler means the efficiency of the complete steam generating unit, including furnace, economizer and air preheater. First step is to figure the pounds of water actually evaporated per pound of fuel fired. Multiply this by the Btu added to one pound of water to get the heat output of the boiler per pound of fuel burned. Efficiency is output divided by input, so divide this last by heat value of one pound of fuel to get the efficiency.

In the first example above suppose that the boiler unit burns 1450 lb per hour of coal having a heat value of 13,750 Btu per pound, and evaporates 13,980 lb of water per hour. Then evaporation per pound of fuel is 13,980 ÷ 1450 = 9.64 lb water. In this case the heat delivered per pound of steam figured 1020.3 Btu, so the output per pound of fuel is 1020.3 × 9.64 and the efficiency is 1020.3 × 9.64 ÷ 13,750 = 0.715 = 71.5%.

Boiler Charts

While it is more accurate to work such problems directly from the steam tables, it is more convenient, and close enough for some purposes, to use charts like the three here presented.

Of these Chart 2 will be the most useful because it incorporates all the required steam table data. For any feedwater temperature, and for any steam pressure and temperature, Chart 2 gives the heat required to convert the liquid into steam. Also, where desired, it gives directly the enthalpy of steam and of liquid water.

Charts 1 and 3 are less basic in character because the simple calculations they replace are easily carried out by slide rule or longhand as explained in this article. Whether or not to use Charts 1 and 3 will be a matter of personal preference and of the degree of accuracy required. For example, Chart 3 should be dependable to about ½ per cent boiler efficiency.

Certain long established standards of boiler output and performance use the so-called "evaporation from and at 212," meaning the number of pounds of water at 212 F converted into steam at 212 F that would absorb the same amount of heat as the actual evaporation under actual conditions of temperature and pressure.

Evaporation Factor

First step is to compute the "factor of evaporation," the actual heat required per pound divided by 970.4 Btu, which is the heat per pound "from and at 212." Thus if the actual heat required is 1020.3 Btu per lb, the factor will be 1020.3 ÷ 970.4 = 1.052. If the actual evaporation per pound of coal is 9.65 the equivalent evaporation will then be 9.65 × 1.052 = 10.15 lb "from and at 212." Such problems can be conveniently solved by Chart 1.

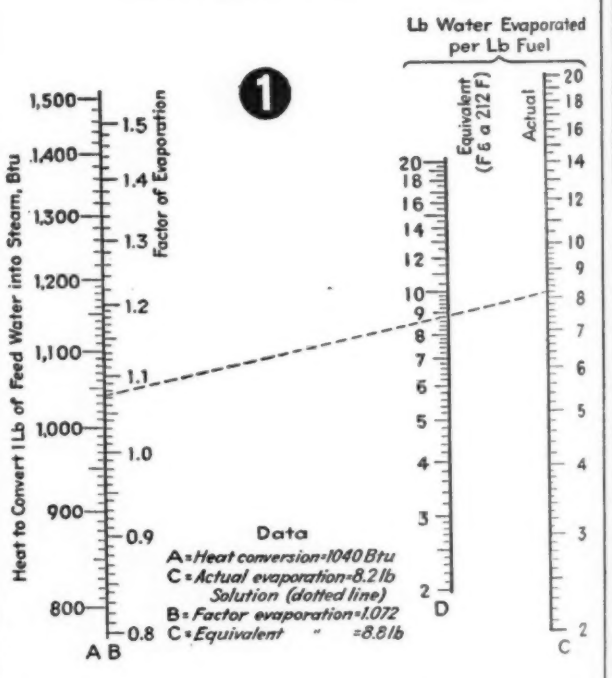


Chart for factor of evaporation and equivalent evaporation. First, working from Chart 2 or from steam tables, determine heat required to convert one pound of feed water into steam at the actual boiler pressure and temperature. Enter this value on *A*. If desired, factor of evaporation can be read on *B*. Connect *A* and *B* with actual evaporation per pound fuel (scale *C*). On *D* read equivalent evaporation "from and at 212" per pound of fuel

CONVENIENT CHARTS FOR BOILER PERFORMANCE

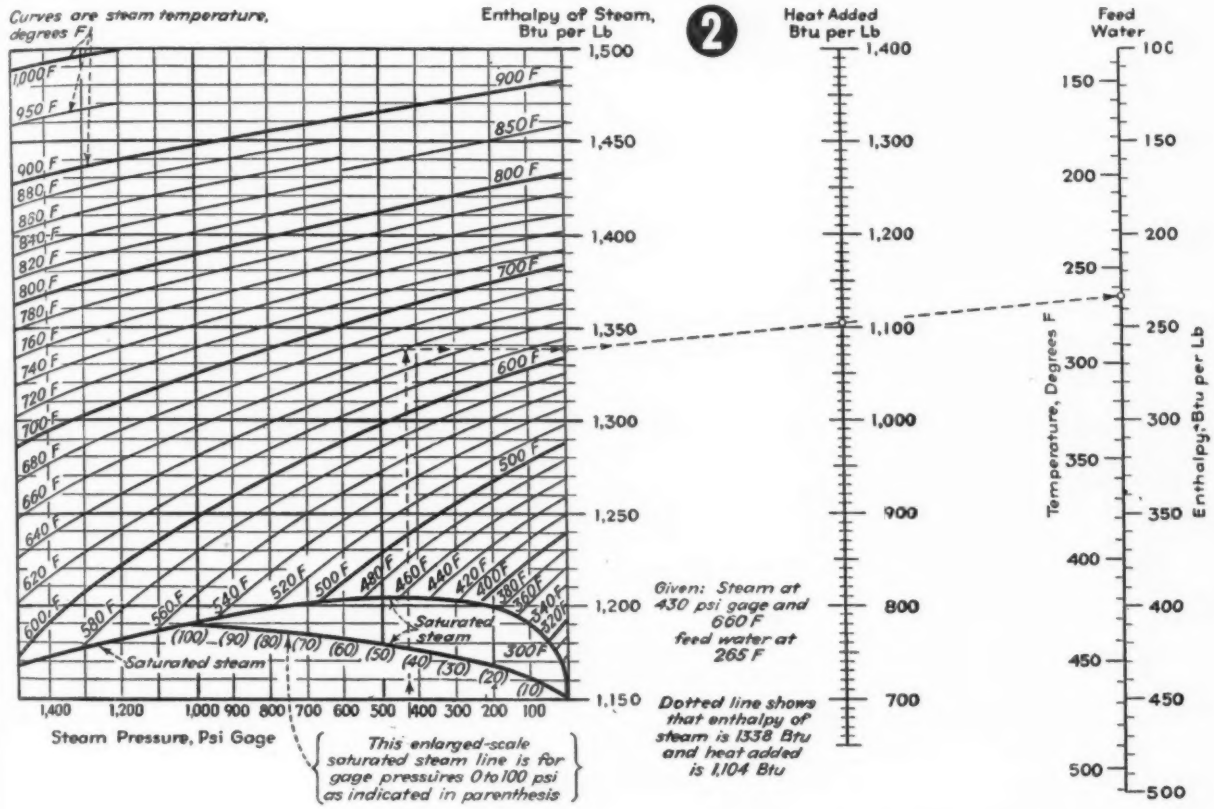

2
Curves are steam temperature, degrees F
Enthalpy of Steam, Btu per Lb
Heat Added Btu per Lb
Feed Water
Temperature, Degrees F
Enthalpy, Btu per Lb
Steam Pressure, Psi Gage
Saturated steam
Saturated steam
This enlarged-scale saturated steam line is for gage pressures 0 to 100 psi as indicated in parenthesis
Given: Steam at 430 psi gage and 660 F feed water at 265 F
Dotted line shows that enthalpy of steam is 1338 Btu and heat added is 1,104 Btu

Chart for heat required to convert one pound of feed water into steam under any given conditions of pressure and temperature. From steam pressure (gage) on lower horizontal scale at left move straight up to the steam temperature (or to the saturation line in case of saturated steam). Move horizontally right to scale for enthalpy of steam. Run straight edge from this point to feed-water temperature on right-hand scale. This will cross intermediate scale at Btu added to steam. Charts 1, 2 and 3 designed by P. W. Swain.

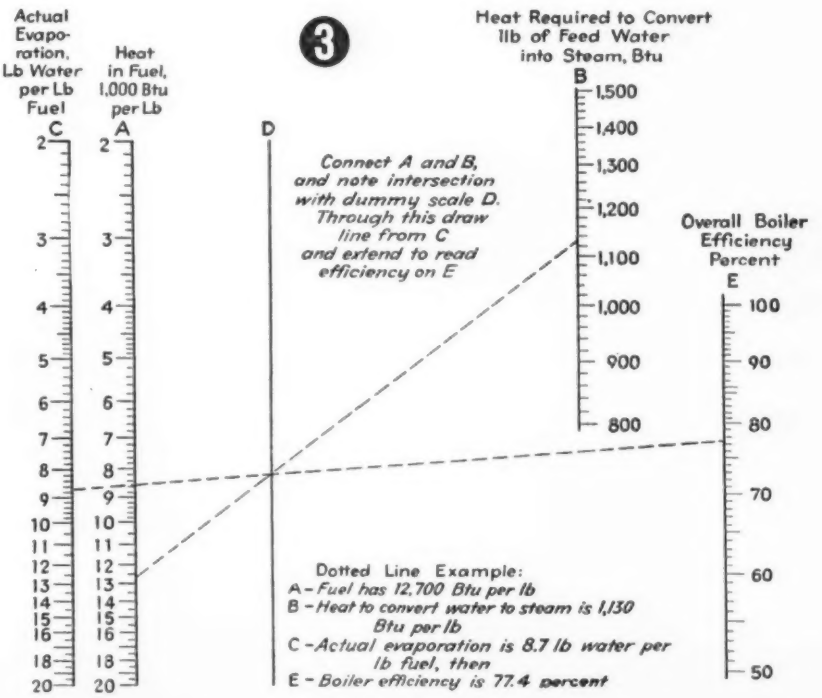

3
Actual Evaporation, Lb Water per Lb Fuel
Heat in Fuel, 1,000 Btu per Lb
Heat Required to Convert 1lb of Feed Water into Steam, Btu
Overall Boiler Efficiency Percent
Connect A and B, and note intersection with dummy scale D. Through this draw line from C and extend to read efficiency on E
Dotted Line Example:
A - Fuel has 12,700 Btu per lb
B - Heat to convert water to steam is 1,130 Btu per lb
C - Actual evaporation is 8.7 lb water per lb fuel, then
E - Boiler efficiency is 77.4 percent

Chart for boiler efficiency. Connect heat value of fuel (*A*) with heat required to convert one pound of feedwater into steam (*B*). Value of *B* is obtained from Chart 2, or may be figured directly from the steam tables. Through the intersection of this connecting line with dummy scale (*D*) draw line from actual evaporation per pound of fuel (*C*). This line, projected, cuts scale *E* at the resulting boiler efficiency.

This chart can be read reliably to about ½% efficiency. For closer work figure long hand or by slide rule, as explained in the text

TURBINES & ENGINES

ALL EXAMPLES are based on Steam Tables 1, 2 and 3 in *Thermodynamic Properties of Steam*, by Keenan and Keyes, John Wiley & Sons, New York. These tables are explained in "Steam Tables Simplified," POWER *Handbook*, Part 1, December POWER, 1943, (since reprinted).

Horsepower

The brake horsepower of an engine or turbine may be figured by the formula: $BHP = 159 \times RPM \times \text{torque} \div 10{,}000{,}000$

Here torque is in pound-inches, product of pound load on brake arm by arm length, inches.

Problem: In a brake test an engine running 250 rpm carries 1200 lb at 20-in. brake arm. What is brake horsepower?

Torque is $1200 \times 20 = 24{,}000$ lb in. $BHP = 159 \times 250 \times 24{,}000 \div 10{,}000{,}000 = 95.4$.

Indicated horsepower of an engine is power delivered to pistons by the steam. $P \times L \times A \times N \div 33{,}000$. Here P is mean effective pressure, psi, from the indicator diagram. L is stroke, ft; A is net area of piston face, sq in.; N is working strokes per min.

Problem: Find IHP of crank end of a single-cylinder double-acting engine if MEP is 45 psi, L is 1.667 ft, net piston area is 220 sq in. and speed 250 rpm.

IHP $= 45 \times 1.667 \times 220 \times 250 \div 33{,}000 = 125$.

All remaining comments regarding steam turbines apply equally to steam engines.

Net heat supplied to a turbine per pound of steam is enthalpy of steam at throttle, minus that of boiler feedwater at temperature corresponding to exhaust pressure.

Thermal Efficiency

Problem: A turbine generator unit receives steam at 200 psi abs and 620 F. Exhaust pressure is 16 psi abs. Steam rate is 20 lb per kwhr. What is thermal efficiency?

Enthalpy steam.....1332.5
Enth sat liq, 16 psi... 184.4

Net input per lb.....1148.1

Input per kwhr is $1148 \times 20 = 22{,}960$ Btu. Since 1 kwhr equals 3413 Btu, thermal efficiency = output ÷ input = $3413 \div 22{,}960 = 0.149 = 14.9\%$.

Thermal efficiencies based on *IHP* or *BHP* are figured in the same way, using the steam consumption per hphr and 2544 Btu = 1 hphr.

Perfect Turbine

A perfect (imaginary) steam turbine, without friction, windage or radiation losses, is a useful standard of comparison. The Mollier diagram (Keenan and Keyes tables) is widely used for turbine computations. The reduced and simplified extract (Fig. 1) is for purposes of explanation.

Horizontal lines are lines of constant *enthalpy*. Vertical lines are lines of constant *entropy*. On this grid are plotted steam curves for constant pressure, temperature and quality.

For present purposes, entropy may be defined as that property which does not change when steam is expanded in a *perfect* turbine. Such expansion is represented by a vertical line from the intersection of throttle pressure and temperature to the curve for back pressure.

Line *AB* represents perfect expansion from 200 psi abs and 620 F to 16 psi abs. Going from *A* to *B*, enthalpy drops from 1333 Btu to 1110 Btu, a net drop of 223 Btu. The perfect turbine will convert this into useful power with steam rate of $2544 \div 223 = 11.4$ lb per hphr, or $3413 \div 223 = 15.3$ lb per kwhr.

Engine Efficiency

If an actual turbine, with the same steam conditions, consumes 25 lb steam per kwhr, its performance is $15.3 \div 25 = 0.612$, or 61.2% as good as the perfect turbine. This is called the *efficiency ratio*, or the *engine efficiency*.

Note that the entropy increases when steam is expanded along *AD*, representing an imperfect (actual) turbine, and that the enthalpy drop is here less than for perfect expansion.

Line *AC* might represent a turbine of zero efficiency or a reducing valve. Here the enthalpy drop is zero and the entropy increase a maximum.

Actual Steam Rates

The Mollier chart permits figuring the steam rate of a perfect turbine. From this the probable steam rate of an actual turbine can be estimated. Divide the theoretical steam rate by the estimated engine efficiency.

Those tabulated below are merely typical. Actual figures will vary with make, price, design, etc.

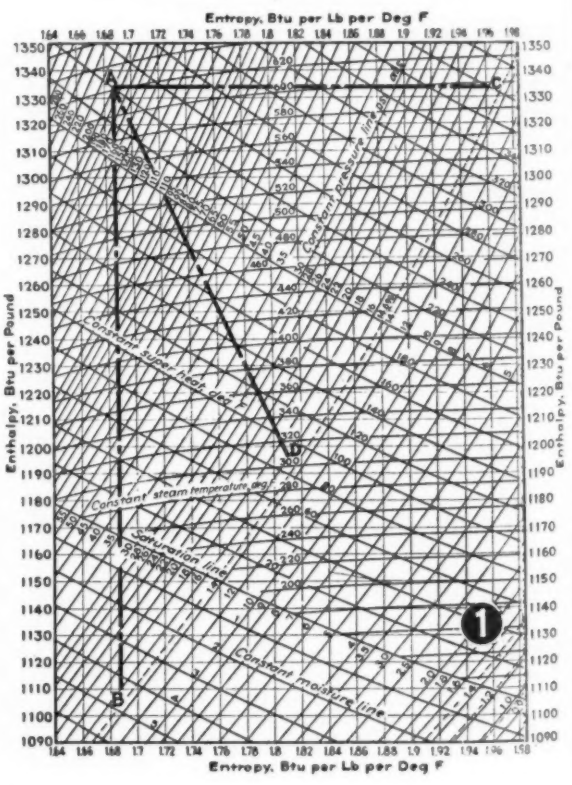
Chart 2 quickly gives the steam rate of a perfect turbine for any steam conditions.

Typical Full-Load Engine Efficiencies, %

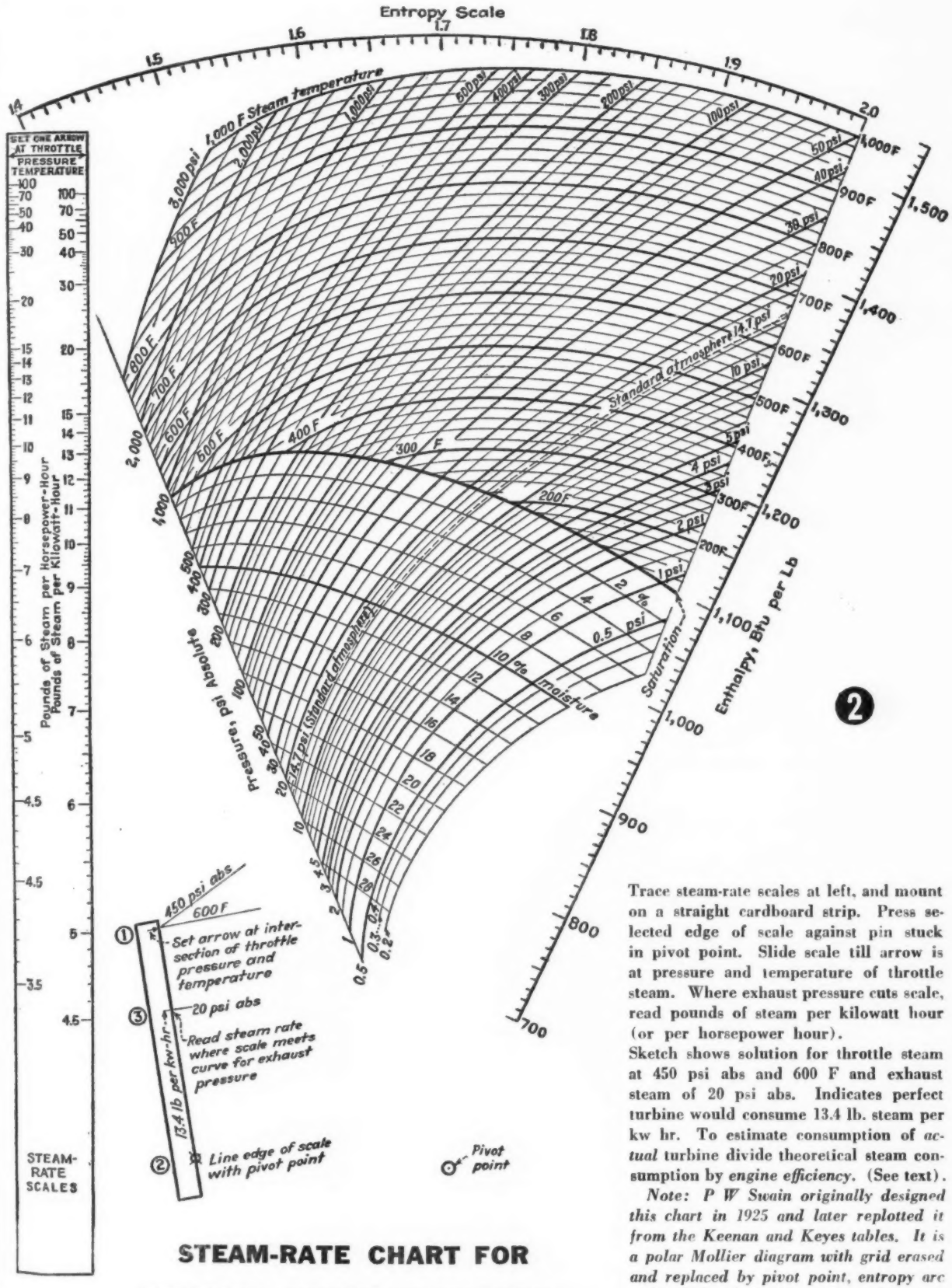
	200 kw	500 kw	1000 kw	2000 kw	5000 kw
Non-condensing uniflow engine...	64	71	74	..	..
Non-condensing turbine	59	61	65	70	75
Condensing turbine	57	59	63	68	73

(*Note: These efficiencies include generator losses*)

EXPANSION OF STEAM



Simplified section of Mollier diagram. Line *AB* represents the expansion of steam in a perfect turbine from 200 psi abs, 620 F, to a back pressure of 16 psi abs.



STEAM-RATE CHART FOR PERFECT ENGINE OR TURBINE

Trace steam-rate scales at left, and mount on a straight cardboard strip. Press selected edge of scale against pin stuck in pivot point. Slide scale till arrow is at pressure and temperature of throttle steam. Where exhaust pressure cuts scale, read pounds of steam per kilowatt hour (or per horsepower hour).

Sketch shows solution for throttle steam at 450 psi abs and 600 F and exhaust steam of 20 psi abs. Indicates perfect turbine would consume 13.4 lb. steam per kw hr. To estimate consumption of *actual* turbine divide theoretical steam consumption by *engine efficiency*. (See text).

Note: P W Swain originally designed this chart in 1925 and later replotted it from the Keenan and Keyes tables. It is a polar Mollier diagram with grid erased and replaced by pivot point, entropy arc and radial enthalpy line. To read entropy of any point move out radially to circular scale. To read enthalpy swing an arc (around pivot) to radial scale at right.

DIESELS, GAS ENGINES

THE AIM HERE is to bring together in condensed form some useful basic data for gas and diesel engines.

Gas Engines

Table below gives data on most of the gases commonly available for engine fuels. Air required for perfect mixture ranges from 0.7 to 1.0 cu ft per 100 Btu, depending on type of gas. For rough estimates assume 1 cu ft of air needed for 100 Btu, so 150-Btu producer gas would take about 1.5 cu ft per cu ft of gas, while a 1000-Btu natural gas would take about 10 cu ft.

Although table below gives *high* heat value (total amount of heat released by combustion of fuel) commercial guarantees of performance are generally made on the basis of *low* or *net* heat value, which allows for the fact that no engine can make use of the heat required to evaporate moisture produced by the combustion of hydrogen in the fuel. Low or net heat value is less than high by about zero for blast-furnace gas, about 5% for producer gas and about 10% for water gas and natural gas.

Problem: A gas engine consumes 13.2 cu ft per hphr of a natural gas having a low-heat value of 905 Btu. What would be approximate consumption of water gas with 240-Btu low-heat value?

Consumption should be $13.2 \times 905 \div 240 = 49.7$ cu ft per hphr, approximately.

This simple method of predicting performance of a gas engine, burning one gas, from tests made with another, is based on the well established fact that the heat rate of a gas engine, in Btu consumed per bhphr, remains practically constant for a given load no matter what gas is used (within wide limits) *if the heat consumption is based on the low heat value.* In short, the engine, in both cases, makes equally good use of the heat units that are commercially available.

Diesel Engines

In the oil-measurement table, weight and gravity relations are exact. Btu values are necessarily averages but they will prove reasonably close for most oils.

The API gravity degrees are the standard of the American Petroleum Institute, generally preferred to the Baume scale.

Gravity Corrections

For most oils the change of API gravity with temperature is about 0.07 deg API for every deg F. The API number rises with increase in temperature. Standard measurements are made at 60 F.

Problem: If an oil is 22 deg API at 60 F, what will be approximate API at 42 F?

Temperature drop is 18 F. API drop is approximately $0.07 \times 18 = 1.26$. Taking the nearest whole number, this gives an API of 21 at 42 F.

Where oil is delivered at a temperature above or below 60 F, gallonage correction can be figured from the two API values (at actual temperature and 60 F) but it is easier and just as accurate to figure that the volume changes 4 parts per 10,000 for every degree change in temperature.

Problem: A batch of oil purchased measures 9500 gal as delivered at 45 F. What are equivalent standard gallons at 60 F?

Correction is $9500 \times 15 \times 4 \div 10{,}000 = 57$ gal. Volume corrected to 60 F is $9500 + 57 = 9557$ gal.

Fig. 1, 2, 5 and 6 and the table on page 87 are based on material appearing in the book *Diesel and Gas Engine Power Plants* by Glenn C Boyer.

DATA ON FUEL GASES

Fuel	*Average composition*	*High heat value, Btu/cu ft*	*Remarks*
Blast-furnace gas	58% N_2, 27% CO, 12% CO_2, 2% H_2, some CH_4	90–100	Good fuel when cleaned — used mainly at source
Butane	C_4H_{10} (usually has some butylene C_4H_8 and propane C_3H_8)	3200–3260	Liquefies under slight pressure, sold as liquid
Casinghead gas	Varies, mostly butane & propane	1200–2000	Used mostly in oil fields
Carbureted water gas	35% H_2, 34% CO, 15% CH_4, 13% C_2H_4, 2% N_2, 1% CO_2	500–600	Good fuel, but usually costly. Part of most city gas
Coke-oven gas	48% H_2, 32% CH_4, 8% N_2, 6% CO, 3% C_2H_4, 2% CO_2, 1% O_2	500–600	Good fuel when cleaned, often used at source
Natural gas	Varies, mostly CH_4, C_2H_6, C_3H_8	950–2200	Ideal fuel, piped to point of use
Oil gas	54% H_2, 27% CH_4, 10% CO, 3% N_2, 3% CO_2, 3% C_2H_4	500–550	Used on West Coast, often mixed with coke-oven gas
Producer gas	59% N_2, 22% CO, 11% H_2, 6% CO_2 2% CH_4	135–165	Requires cleaning
Propane	C_3H_8	2500	Similar to butane
Refinery gas	Varies, mostly butane and propane	1200–2000	Used mainly at refineries, some piped
Sewage gas	65% CH_4, 30% CO_2, 2% H_2, 3% N_2, traces of O_2, CO, H_2S	600–700	Many disposal plants meet all power needs with this fuel

OIL MEASUREMENT AT 60F

Gravity degrees API	Specific gravity	Lb per gallon	Btu per lb	Btu per gal	Lb per 42-gal barrel	Weight lb per cubic ft
10	1.0000	8.33	18,540	154,620	350.15	62.36
11	.9930	8.27	18,590	153,740	347.71	61.93
12	.9861	8.22	18,640	153,220	345.28	61.50
13	.9792	8.16	18,690	152,510	342.88	61.07
14	.9725	8.10	18,740	151,790	340.53	60.65
15	.9659	8.05	18,790	151,260	338.22	60.24
16	.9593	7.99	18,840	150,530	335.91	59.83
17	.9529	7.94	18,890	149,980	333.64	59.42
18	.9465	7.89	18,930	149,360	331.42	59.03
19	.9402	7.83	18,980	148,610	329.23	58.64
20	.9340	7.78	19,020	147,980	327.05	58.25
21	.9279	7.73	19,060	147,330	324.91	57.87
22	.9218	7.68	19,110	146,760	322.81	57.49
23	.9159	7.63	19,150	146,110	320.71	57.12
24	.9100	7.58	19,190	145,460	318.65	56.75
25	.9042	7.53	19,230	144,800	316.59	56.39
26	.8984	7.49	19,270	144,330	314.58	56.03
27	.8927	7.44	19,310	143,670	312.60	55.68
28	.8871	7.39	19,350	142,990	310.63	55.32
29	.8816	7.35	19,380	142,440	308.70	54.98
30	.8762	7.30	19,420	141,770	306.81	54.64
31	.8708	7.26	19,450	141,210	304.92	54.31
32	.8654	7.21	19,490	140,520	303.03	53.97
33	.8602	7.17	19,520	139,960	301.18	53.64
34	.8550	7.12	19,560	139,270	299.37	53.32
35	.8498	7.08	19,590	138,690	297.57	53.00
36	.8448	7.04	19,620	138,120	295.80	52.68
37	.8398	7.00	19,650	137,550	294.04	52.37
38	.8348	6.96	19,680	136,970	292.32	52.06
39	.8299	6.92	19,720	136,460	290.64	51.76
40	.8251	6.87	19,750	135,680	288.91	51.46
41	.8203	6.83	19,780	135,090	287.23	51.16
42	.8156	6.79	19,810	134,510	285.55	50.86

CONVENIENT ENGINE CHARTS

Air Required by Diesel Engines

Dry air at 60 F and 29.9 in barometer

Type of Engine	Lb per hr	Cfm air
4-stroke cycle mech injection..	10–13	2.2–2.8
4-stroke cycle air injection....	12–15	2.6–3.3
2-stroke mech injection, pump scavenging.....	22–23.5	4.8–5.1
2-stroke cycle air injection....	20–22	4.3–4.8
2-stroke mech injection, crankcase scavenging.....	18	3.9

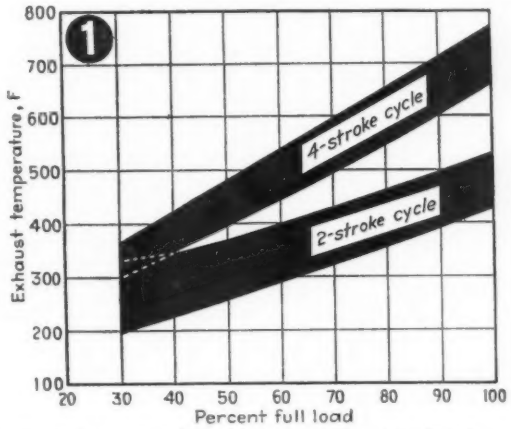


Fig. 1—Range of exhaust temperatures for diesels

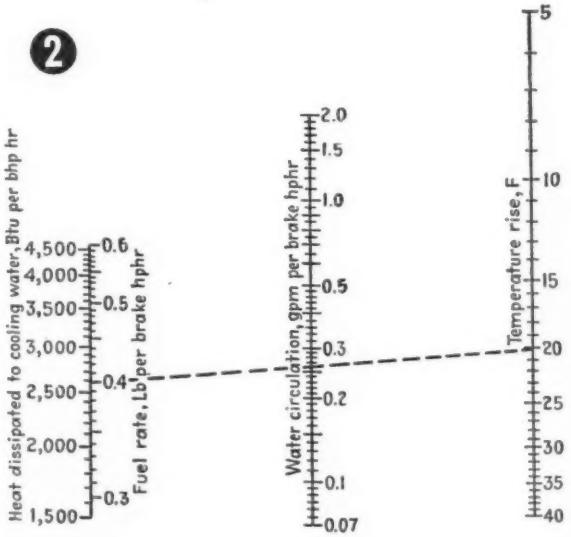
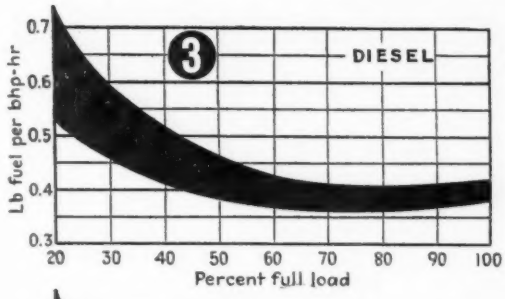


Fig. 2—Diesel jacket-water chart: Run straight line from heat dissipated per bhphr (left) to temperature rise (right). This will cut middle scale at gallons water circulated per bhphr. Fuel-rate scale (left) is based on assumption that half engine heat loss goes to jacket. To avoid figuring heat dissipated, chart may be entered directly with the fuel-rate (0.4 lb per bhphr is a fair average figure). For oil cooling add 800 Btu per bhphr, and another 200 Btu (or more) if manifold is jacketed. *Chart published by courtesy of Glenn C. Boyer*



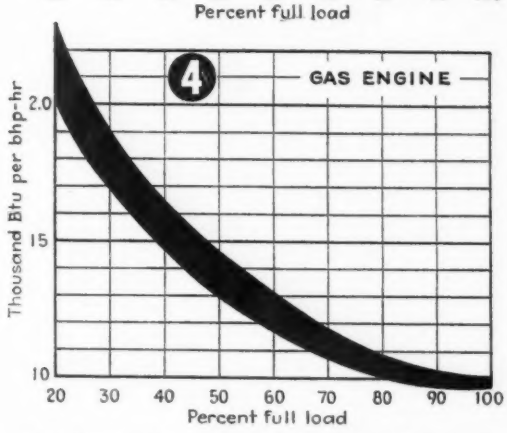


Fig. 3 & 4—Usual range of fuel-consumption rates for modern diesels (Fig. 3) and Btu rates for modern gas engines (Fig. 4). Latter are based on *low*, or *net*, heat values. All curves are for test conditions. Service consumption may run slightly higher.

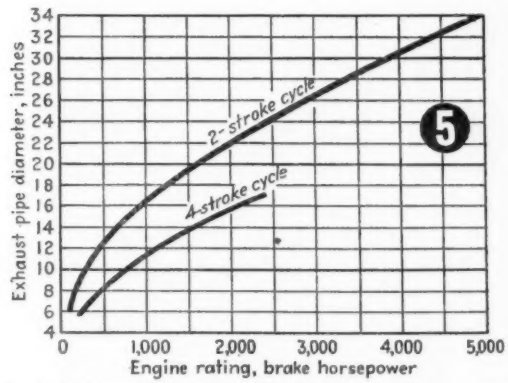


Fig. 5—Exhaust-pipe sizes for diesel engines, average conditions. *Data prepared by Max Rotter*

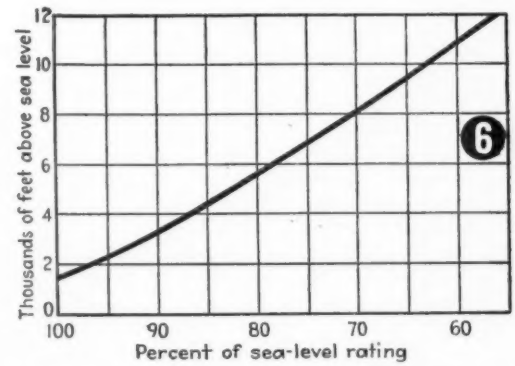


Fig. 6—Diesel ratings for sea level are good to 1500 ft elevation. For higher elevations curve gives maximum power in percent of sea-level rating.

COMPRESSORS & FANS

Absolute pressure is atmospheric plus gage press.

Atmospheric pressure is normally 14.7 psi at standard sea level. Decreases 0.1 psi per 200 ft of elevation up to about 4000 ft.

Barometer reading of atmospheric pressure is normally 30 in. at sea level. Decreases 0.1 in. per 100 ft of elevation up to 4000 ft. Every inch of barometer is 0.49 psi. A barometer of 28.2 in. is $0.49 \times 28.2 = 13.8$ psi abs atm pressure.

Absolute temperature is Fahr temperature plus 460.

Cfm means cu ft per min. It may refer to *free air* (See below.), to air under other specified conditions or to piston displacement.

Specific volume is the volume of 1 lb of air, cu ft.

Free air is air in the actual condition supplied to the compressor suction at the time and place under consideration. *It, therefore, is not necessarily air at 14.7 psi abs and 60 F or 68 F.*

Compressor output is generally given in cfm of free air, *not* cfm measured in compressed state.

Compressor displacement is the cfm swept out by the piston. In a multi-stage compressor, use LP piston only.

Volumetric efficiency is cfm output expressed as a percentage of cfm displacement. If output is 1700 cfm and displacement is 2000 cfm, volumetric efficiency is $1700 \div 2000 = 0.85 = 85\%$.

Capacity Problem

Problem: Sea-level barometer is 29.6 in. Elevation is 2000 ft. Inlet temperature is 60 F. Compressor displacement is 1350 cfm; volumetric efficiency 80%. What weight air is compressed per hour?

Abs temp is $460 + 60 = 520$. Elevation would depress barometer 0.1 in. per 100 ft, or 2.0 in. for 2000 ft, so barometer at compressor would be $29.6 - 2.0 = 27.6$ in. Atm pressure is $27.6 \times 0.49 = 13.5$ psi abs. Chart below gives specific volume of air as 14.25 cu ft per lb.

Cfm of free air is $1350 \times 0.80 = 1080$. Weight of free air per min is $1080 \div 14.25 = 75.8$ lb. Weight per hour is $60 \times 75.8 = 4548$ lb.

Isothermal compression is compression without temperature rise; the heat of compression is removed by the jacket as fast as formed. In actual practice this is impossible. Isothermal compression is merely an ideally perfect compression standard with which actual compression may be compared.

The formula for isothermal compression is $PV = \text{constant}$. Absolute pressure times volume at any point during compression equals the same product at any other point.

Problem: Air is compressed isothermally from normal zero gage (14.7 psi abs). What will be the pressure when the piston has completed two-thirds of its stroke, assuming clearance volume is zero?

Volume of gas is one-third volume at start of stroke, so abs pressure is $3 \times 14.7 = 44.1$ psi abs or $44.1 - 14.7 = 29.4$ psi gage.

The general formula for a compression line is $PV^n = a$ constant. This means that absolute pressure times the nth power of the volume is the same for all points along the compression line. The case of isothermal compression, just considered, is one in which the value of the exponent n is 1.

Adiabatic compression is the case where the exponent n is 1.4. This is obtained where compression is without piston friction or wire-drawing and with no loss of heat to jacket. This curve is approached fairly closely by actual compressors.

As indicated by the higher value of n, the adiabatic

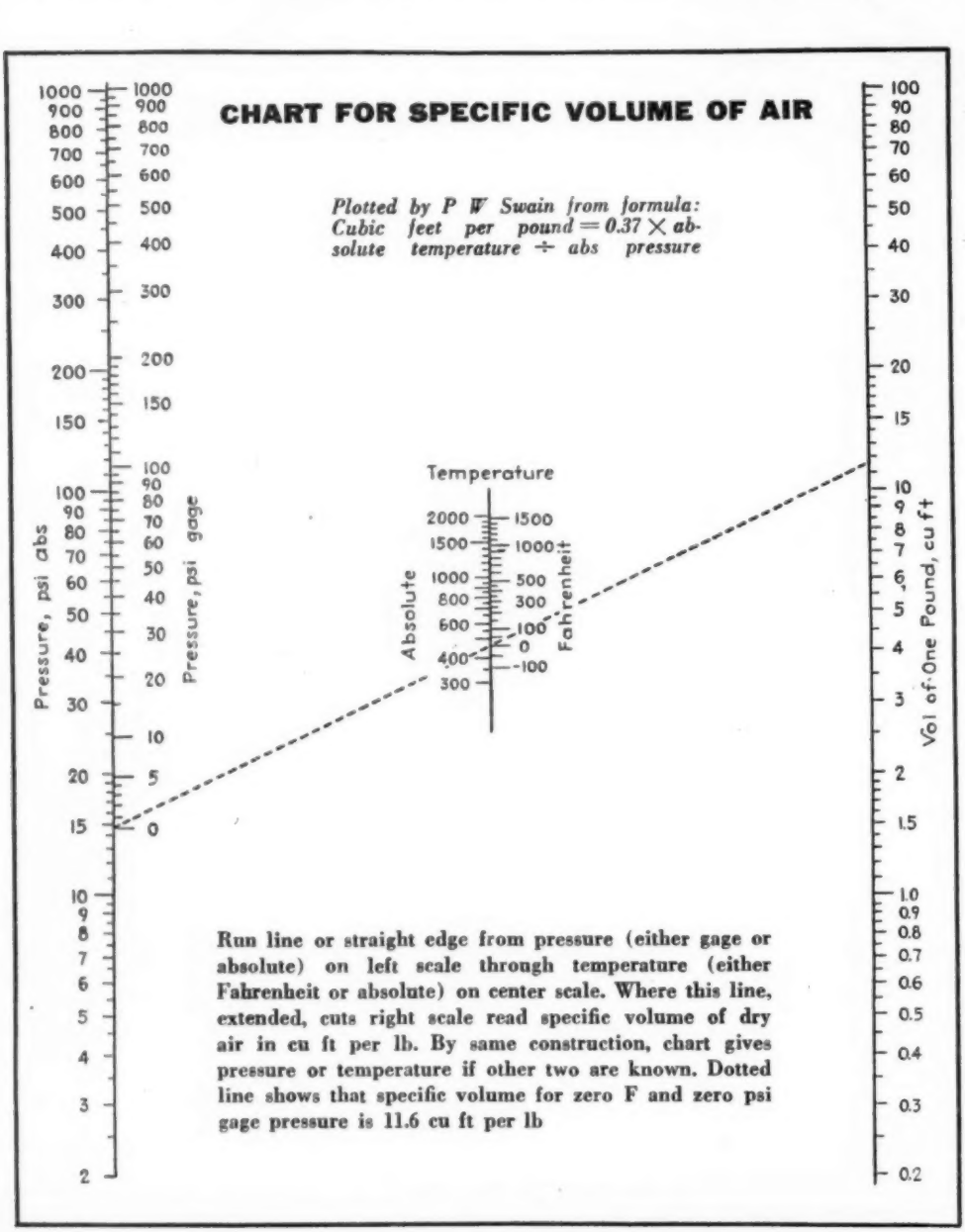


CHART FOR SPECIFIC VOLUME OF AIR
Plotted by P W Swain from formula:
Cubic feet per pound = 0.37 × absolute temperature ÷ abs pressure
Pressure, psi abs
Pressure, psi gage
Temperature
Absolute
Fahrenheit
Vol of One Pound, cu ft
Run line or straight edge from pressure (either gage or absolute) on left scale through temperature (either Fahrenheit or absolute) on center scale. Where this line, extended, cuts right scale read specific volume of dry air in cu ft per lb. By same construction, chart gives pressure or temperature if other two are known. Dotted line shows that specific volume for zero F and zero psi gage pressure is 11.6 cu ft per lb

curve runs higher (is steeper) than the isothermal, because the heat of compression stays in the gas, raising its temperature and hence its pressure.

Thus, it takes more power to compress air along the adiabatic curve, as is shown in Fig. 1.

Multi-Stage Compression

Fig. 2 shows how 2-stage compression reduces this waste of power by bringing the air nearly back to the original temperature in the intercooler between the LP and the HP cylinders.

Aside from power saving, multi-stage compression keeps the air temperature down to a safe level even with a high ratio of delivery pressure to suction pressure. Also, it improves volumetric efficiency.

The table gives the theoretical power required to compress 1000 cfm air from 14.7 psi abs to various final pressures with various values of n. For efficiency studies use the column for $n=1$ (isothermal compression), or that for $n=1.4$ (adiabatic). To get actual horsepower required, divide this theoretical power by the over-all efficiency of the given compressor, based on isothermal or adiabatic as case may be.

Problem: Using tabulated efficiency (assuming no other efficiency data available) what is probable power required at the coupling to drive a 2-stage compressor compressing 800 cfm free air if suction is 14.7 psi abs and discharge 115 abs?

Theoretical isothermal power from table is 130 hp for 1000 cfm or $0.8 \times 130 = 104$ hp for 800 cfm. For nearest compression ratio of 8, table gives an isothermal efficiency of 69% (over-all). Then power at coupling would be $104 \div 0.69 = 151$ hp.

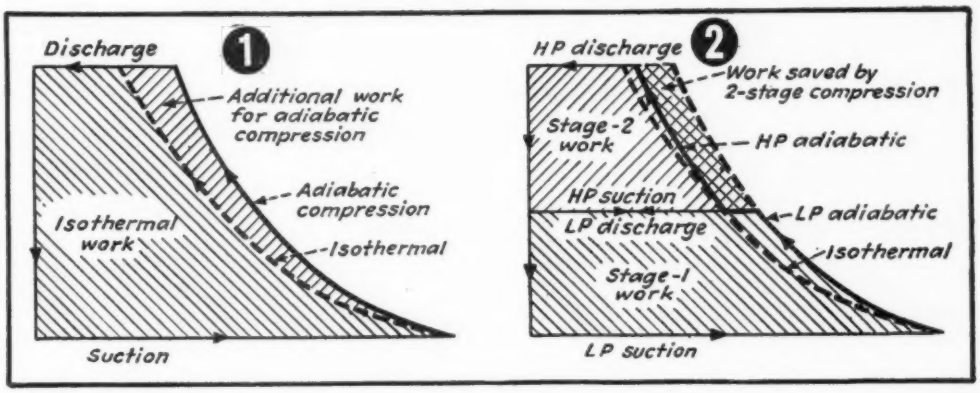
Fans and Blowers

For fans and blowers pressure differences are measured in inches of water (rather than psi), using a glass U-tube with water legs. If one side of the U is exposed to atmosphere and the other connected to a tube facing directly upstream in the fan discharge, the inches of water will be the *total discharge pressure*, including the velocity head. If the connected tube is at right angles to the flow, the reading will be the *static pressure*, a lower value.

Theoretical horsepower to drive a fan is 0.000157 times cfm times total delivery pressure, inches of water. This is called *static air horsepower* if static pressure is used, and *total air horsepower* if total pressure is used. Efficiency, which is the air-hp output divided by driving hp, or input hp, should be labeled *static*, or *total* as case may be.

Fig. 1—Single-stage compression follows the adiabatic line. Area between adiabatic and isothermal is waste power

Fig. 2—Two-stage compression with intercooling comes closer to ideal isothermal and thereby reduces power waste



THEORETICAL HP TO COMPRESS 1000 CFM AIR

Final pressure psi abs	Comp ratio	n = 1.4			n = 1.3			n = 1.2			n = 1.0
		Single stage	Two stage	Three stage	Single stage	Two stage	Three stage	Single stage	Two stage	Three stage	1 or more stages
30	2.04	51	48	47	50	47	47	48	46	46	45
35	2.38	63	58	57	62	57	56	59	56	55	55
40	2.72	73	67	66	71	66	65	69	65	64	64
45	3.06	83	76	74	81	75	73	78	74	72	71
50	3.40	91	85	82	89	83	81	85	82	80	78
55	3.74	100	93	89	98	90	88	93	89	86	84
60	4.07	110	98	95	106	97	94	100	95	92	89
65	4.42	118	105	102	112	103	100	107	101	98	95
70	4.76	125	111	108	119	109	105	113	106	103	99
75	5.10	133	116	114	125	115	110	119	111	109	104
80	5.45	140	121	119	131	120	115	124	116	114	108
85	5.78	146	126	122	137	124	120	129	120	118	112
90	6.12	151	131	126	142	128	124	134	124	121	116
95	6.45	156	135	130	147	132	128	139	128	125	119
100	6.80	162	140	134	153	136	131	143	131	129	121
105	7.14	167	144	138	158	140	135	147	135	133	124
110	7.48	171	147	141	163	143	139	150	139	136	127
115	7.82	176	151	145	167	147	142	154	142	139	130
120	8.16	181	155	148	172	151	145	158	145	142	133
125	8.50	186	158	152	176	154	147	162	148	145	136
130	8.85	190	162	155	180	158	150	166	152	148	139
135	9.18	194	165	158	184	161	152	170	155	151	141
140	9.52	199	169	160	188	164	155	173	157	153	143
145	9.85	203	172	162	191	166	158	176	159	155	145
150	10.20	207	174	165	195	169	162	179	162	158	148
160	10.88	215	180	171	202	174	167	185	168	163	152
170	11.56	224	185	175	209	179	172	190	173	168	156
180	12.25	232	190	179	215	184	176	196	177	172	159
190	12.91	240	195	183	221	189	180	201	181	176	162
200	13.60	248	200	187	228	193	183	207	185	179	166
210	14.30	256	205	192	234	197	187	211	188	181	169
220	14.95	264	209	196	239	201	191	216	192	184	171

Compression exponent n is 1.0 for isothermal and 1.4 for adiabatic. Suction is 14.7 psi abs.
Two- and three-stage compressors based on best receiver pressure and perfect intercooling.

Typical compressor efficiencies

Compression ratio	2	3	4	5	6	7	8	9	10
Efficiency* single cylinder—percent	68	69	67	64	61	60	59	58	57
Efficiency* two-stage—percent	..	..	67	68	69	70	69	68	68

* Efficiency is based on isothermal compression and includes mechanical losses.

REFRIGERATION FACTS

WITH AMMONIA or any other refrigerant (See two large tables.) refrigeration results from boiling of the liquid into vapor. This soaks up heat from the surroundings.

At standard atmospheric pressure (14.7 psi abs) liquid ammonia boils at –28 F, absorbing 590 Btu for every pound vaporized. Ammonia table at right gives pressures and other data for liquid and vapor at the indicated saturation temperatures (boiling points). The heat to vaporize the liquid is labeled *latent heat.*

This table shows that reducing *suction pressure* (pressure at compressor suction, same as in evaporator) produces colder refrigeration. The lower temperature is obtained at the cost of higher power consumption per *ton* of refrigeration. In addition, compressor capacity falls because the pistons are handling lighter vapor (hence, less weight of ammonia per stroke). The two top tables on right page show the effect of varying suction and condenser pressures.

Refrigerating capacity and load are measured in *tons.* One ton of refrigeration is removal of heat (from outside into the evaporator) at a rate equivalent to the melting of one ton of ice every 24 hr. This figures 288,000 Btu per 24 hr, 12,000 Btu per hr, 200 Btu per min.

Problem: A refrigerating plant circulates 100 lb of ammonia per minute. The evaporator vaporizes the liquid at 9-psi gage (23.7 psi abs). What is the refrigerating output in tons?

Ammonia table shows a latent heat of 576 Btu, so the heat absorption is 576x100 = 57,600 Btu per min. This is 57,600 ÷ 200 = 288 tons of refrigeration.

What happens on the high-pressure side of the system has little effect on the amount of refrigeration produced, but

Credits: Table of properties of calcium chloride brine from booklet, "Dow Calcium Chloride for Refrigeration," Dow Chemical Co. Charts for theoretical cubic feet and horsepower from "Marks Mechanical Engineers Handbook." Refrigerant table is from POWER.

CALCIUM CHLORIDE BRINE

Density of brine at 60 F		Percent anhydrous calcium chloride	Freezing point deg F	Pounds 73–75% solid calcium choride	
Specific gravity	Baume scale			Per gal. solution at 60 F	Per cu ft solution at 60 F
1.00	1.0	0.0	32.0	.00	0.0
1.04	5.6	4.7	28.0	.55	4.1
1.08	10.7	9.2	23.4	1.13	8.4
1.10	13.2	11.4	20.3	1.42	10.6
1.12	15.5	13.5	16.5	1.70	12.8
1.14	17.8	15.6	12.0	2.00	15.0
1.16	20.0	17.6	7.0	2.30	17.2
1.18	22.1	19.5	1.4	2.60	19.4
1.20	24.2	21.5	– 5.8	2.90	21.7
1.22	26.2	23.3	–13.2	3.20	24.0
1.24	28.1	25.1	–21.3	3.51	26.2
1.26	29.9	26.9	–30.8	3.83	28.6
1.28	31.7	28.7	–44.1	4.14	31.0
1.29	32.6	29.6	–59.8	4.31	32.2

PROPERTIES OF STANDARD AMMONIA

From U. S. Bureau of Standards—Circ 142, 1923

Temp deg F	Pressure psi		Volume of vapor cu ft/lb	Density of vapor pounds per cu ft	Heat content Btu per lb		Latent heat Btu per lb	Entropy Btu per lb per deg F	
	Abs.	Gage			Liquid	Vapor		Liquid	Vapor
–40	10.41	*8.7	24.86	0.04022	0.0	597.6	597.6	0.0000	1.4242
–35	12.05	*5.4	21.68	.04613	5.3	599.5	594.2	.0126	1.4120
–30	13.90	*1.6	18.97	.05271	10.7	601.4	590.7	.0250	1.4001
–25	15.98	1.3	16.66	.06003	16.0	603.2	587.2	.0374	1.3886
–20	18.30	3.6	14.68	.06813	21.4	605.0	583.6	.0497	1.3774
–18	19.30	4.6	13.97	.07161	23.5	605.7	582.2	.0545	1.3729
–16	20.34	5.6	13.29	.07522	25.6	606.4	580.8	.0594	1.3686
–14	21.43	6.7	12.66	.07898	27.8	607.1	579.3	.0642	1.3643
–12	22.56	7.9	12.06	.08289	30.0	607.8	577.8	.0690	1.3600
–10	23.74	9.0	11.50	.08695	32.1	608.5	576.4	.0738	1.3558
– 9	24.35	9.7	11.23	0.08904	33.2	608.8	575.6	0.0762	1.3537
– 8	24.97	10.3	10.97	.09117	34.3	609.2	574.9	.0786	1.3516
– 7	25.61	10.9	10.71	.09334	35.4	609.5	574.1	.0809	1.3495
– 6	26.26	11.6	10.47	09555	36.4	609.8	573.4	.0833	1.3474
– 5	26.92	12.2	10.23	.09780	37.5	610.1	572.6	.0857	1.3454
– 4	27.59	12.9	9.991	.1001	38.6	610.5	571.9	.0880	1.3433
– 3	28.28	13.6	9.763	.1024	39.7	610.8	571.1	.0904	1.3413
– 2	28.98	14.3	9.541	.1048	40.7	611.1	570.4	.0928	1.3393
– 1	29.69	15.0	9.326	.1072	41.8	611.4	569.6	.0951	1.3372
0	30.42	15.7	9.116	.1097	42.9	611.8	568.9	.0975	1.3352
1	31.16	16.5	8.912	0.1122	44.0	612.1	568.1	0.0998	1.3332
2	31.92	17.2	8.714	.1148	45.1	612.4	567.3	.1022	1.3312
3	32.69	18.0	8.521	.1174	46.2	612.7	566.5	.1045	1.3292
4	33.47	18.8	8.333	.1200	47.2	613.0	565.8	.1069	1.3273
5	34.27	19.6	8.150	.1227	48.3	613.3	565.0	.1092	1.3253
6	35.09	20.4	7.971	.1254	49.4	613.6	564.2	.1115	1.3234
7	35.92	21.2	7.798	.1282	50.5	613.9	563.4	.1138	1.3214
8	36.77	22.1	7.629	.1311	51.6	614.3	562.7	.1162	1.3195
9	37.63	22.9	7.464	.1340	52.7	614.6	561.9	.1185	1.3176
10	38.51	23.8	7.304	.1369	53.8	614.9	561.1	.1208	1.3157
12	40.31	25.6	6.996	0.1429	56.0	615.5	559.5	0.1254	1.3118
14	42.18	27.5	6.703	.1492	58.2	616.1	557.9	.1300	1.3081
16	44.12	29.4	6.425	.1556	60.3	616.6	556.3	.1346	1.3043
18	46.13	31.4	6.161	.1623	62.5	617.2	554.7	.1392	1.3006
20	48.21	33.5	5.910	.1692	64.7	617.8	553.1	.1437	1.2969
22	50.36	35.7	5.671	.1763	66.9	618.3	551.4	.1483	1.2933
24	52.59	37.9	5.443	.1837	69.1	618.9	549.8	.1528	1.2897
26	54.90	40.2	5.227	.1913	71.3	619.4	548.1	.1573	1.2861
30	59.74	45.0	4.825	.2073	75.7	620.5	544.8	.1663	1.2790
35	66.26	51.6	4.373	.2287	81.2	621.7	540.5	.1775	1.2704
40	73.32	58.6	3.971	0.2518	86.8	623.0	536.2	0.1885	1.2618
45	80.96	66.3	3.614	.2767	92.3	624.1	531.8	.1996	1.2535
50	89.19	74.5	3.294	.3036	97.9	625.2	527.3	.2105	1.2453
55	98.06	83.4	3.008	.3325	103.5	626.3	522.8	.2214	1.2373
60	107.6	92.9	2.751	.3635	109.2	627.3	518.1	.2322	1.2294
65	117.8	103.1	2.520	.3968	114.8	628.2	513.4	.2430	1.2216
70	128.8	114.1	2.312	.4325	120.5	629.1	508.6	.2537	1.2140
75	140.5	125.8	2.125	.4707	126.2	629.9	503.7	.2643	1.2065
78	147.9	133.2	2.021	.4949	129.7	630.4	500.7	.2706	1.2020
80	153.0	138.3	1.955	.5115	132.0	630.7	498.7	.2749	1.1991
82	158.3	143.6	1.892	0.5287	134.3	631.0	496.7	0.2791	1.1962
84	163.7	149.0	1.831	.5462	136.6	631.3	494.7	.3833	1.1933
86	169.2	154.5	1.772	.5643	138.9	631.5	492.6	.2875	1.1904
88	174.8	160.1	1.716	.5828	141.2	631.8	490.6	.2917	1.1875
90	180.6	165.9	1.661	.6019	143.5	632.0	488.5	.2958	1.1846
92	186.6	171.9	1.609	.6214	145.8	632.2	486.4	.3000	1.1818
94	192.7	178.0	1.559	.6415	148.2	632.5	484.3	.3041	1.1789
96	198.9	184.2	1.510	.6620	150.5	632.6	482.1	.3083	1.1761
98	205.3	190.6	1.464	.6832	152.9	632.9	480.0	.3125	1.1733
100	211.9	197.2	1.419	0.7048	155.2	633.0	477.8	0.3166	1.1705
105	228.9	214.2	1.313	.7615	161.1	633.4	472.3	.3269	1.1635
110	247.0	232.3	1.217	.8219	167.0	633.7	466.7	.3372	1.1566
115	266.2	251.5	1.128	.8862	173.0	633.9	460.9	.3474	1.1497
120	286.4	271.7	1.047	.9549	179.0	634.0	455.0	.3576	1.1427

*Inches of mercury below one standard atmosphere (29.92 in.)

does greatly influence the power required per ton of refrigeration. The *head pressure* (same as the compressor discharge or condensing pressure) is fixed first by the quantity and temperature of the cooling water. With ample cooling surface in clean condition, and ample water circulation, temperature of condensing ammonia should not be more than 8 or 10 deg hotter than that of the water leaving the condenser.

If this difference is 9 deg, say, and if water leaves the coils at 75 F, the condensing temperature will be 84 F and the corresponding head pressure (See ammonia table.) 149 psi gage.

To reduce power and conserve capacity keep the head pressures as low as possible and the suction pressures as high as needed to produce the necessary refrigerating temperature.

THEORETICAL CFM AMMONIA FOR 1 TON REFRIGERATION

Add 33% for probable actual volume

Suction pressure and corresponding temp		Condenser pressures (psi gage) and corresponding temperatures (deg F)								
Psi gage	Deg F	103 (65 F)	115 (70 F)	127 (75 F)	139 (80 F)	153 (85 F)	168 (90 F)	184 (95 F)	200 (100 F)	218 (105 F)
6	—15	5.35	5.40	5.46	5.52	5.58	5.64	5.70	5.77	5.83
9	—10	4.66	4.73	4.76	4.81	4.86	4.91	4.97	5.05	5.08
13	— 5	4.09	4.12	4.17	4.21	4.25	4.30	4.35	4.40	4.44
16	0	3.59	3.63	3.66	3.70	3.74	3.78	3.83	3.87	3.91
20	5	3.20	3.24	3.27	3.30	3.34	3.38	3.41	3.45	3.49
24	10	2.87	2.90	2.93	2.96	2.99	3.02	3.06	3.09	3.12
28	15	2.59	2.61	2.65	2.68	2.71	2.73	2.76	2.80	2.82
33	20	2.31	2.34	2.36	2.38	2.41	2.44	2.46	2.49	2.51
39	25	2.06	2.08	2.10	2.12	2.15	2.17	2.20	2.22	2.24
45	30	1.85	1.87	1.89	1.91	1.93	1.95	1.97	2.00	2.01

THEORETICAL HORSEPOWER FOR 1 TON REFRIGERATION

Add 50% for probable actual horsepower

Suction pressure and corresponding temp		Condenser pressures (psi gage) and corresponding temperatures (deg F)								
Psi gage	Deg F	103 (65 F)	115 (70 F)	127 (75 F)	139 (80 F)	153 (85 F)	168 (90 F)	184 (95 F)	200 (100 F)	218 (105 F)
6	−15	0.997	1.069	1.145	1.222	1.300	1.410	1.461	1.546	1.630
9	−10	0.903	0.978	1.045	1.118	1.193	1.260	1.347	1.435	1.509
13	−5	0.818	0.883	0.954	1.023	1.094	1.168	1.244	1.321	1.396
16	0	0.735	0.801	0.865	0.933	1.002	1.072	1.147	1.219	1.255
20	5	0.666	0.731	0.795	0.859	0.928	0.998	1.066	1.138	1.212
24	10	0.592	0.663	0.726	0.789	0.854	0.921	0.991	1.060	1.129
28	15	0.541	0.600	0.664	0.728	0.792	0.855	0.922	0.994	1.060
33	20	0.474	0.534	0.592	0.672	0.715	0.780	0.842	0.903	0.974
39	25	0.410	0.466	0.523	0.580	0.599	0.702	0.767	0.829	0 892
45	30	0.351	0.406	0.461	0.518	0.576	0.635	0.694	0.759	0.817

PROPERTIES OF COMMON COMMERCIAL REFRIGERANTS

Refrigerant	Chemical symbol	Hazard factors				Thermal factors								Operating factors				
		Safety code group[1]	Irritant?	Inflammable?	Concentration in air to form explosive mixture	Condensing pressure, 86 F, psi abs	Evaporation pressure 5 F, psi abs	Boiling point, F (atmospheric)	Freezing point, F (atmospheric)	Critical temperature, F	Net refrig effect (86–5 F) Btu per lb	Refrigerant handled lb per min per ton	Piston displacement cu ft per min per ton	React harmfully with lubricating oils?	Mix with lube oil?	Corrosive to metals? (alone)	Corrosive to metals? (with water)	Materials spoiled by exposure to refrigerant
Ammonia	NH_3	2	Yes	Slightly	13–27	169.2	34.3	−28	−107.9	271.2	474.4	0.4	3.4	No	No	No ‡	Copper, alloys	Foods, textiles
Carbon dioxide	CO_2	1	No	No	None	1039.0	334.4	−108.4	−69.9	87.8	55.0	3.6	0.94	No	No	No	Iron, copper ‡	None
Carrene—1 (Dichloromethane)	CH_2Cl_2	1	No	No	None	10.6	1.17	105	−142.0	421.0	134.6	1.5	74.5	No	Yes	No	No	.....
Carrene—2 (Freon—11) (Trichloromonofluoromethane)	CCl_3F	1	No	No	None	18.3	3.0	74.7	−168.0	388.4	67.5	3.0	36.3	No	Yes	No	No	None
Freon—12 (Dichlorodifluoromethane)	CCl_2F_2	1	No	No	None	107.9	26.6	−21.7	−247.0	233.0	51.1	3.9	5.8	No	Yes	No	No	None
Freon—21 (Dichloromonofluoromethane)	$CHCl_2F$	1	No	Slightly	None	31.2	5.3	48.0	−196.6	353.3	89.4	2.2	20.4	No	Yes	No	No	None
Dielene (Dichloroethylene)	$C_2H_2Cl_2$	2	*	.....	5–11	6.9	0.82	122	−70.0	470.0	114.4	1.75	112.6	.....	Yes	....	.....	.....
Ethyl chloride	C_2H_5Cl	2	*	Yes	4–14	27.1	4.7	54.0	−217.7	369.0	142.9	1.4	22.6	.....	Yes	....	.....	.....
Isobutane	$(CH_3)_2CH$	3	**	Yes	2–6	59.5	13.1	10.3	−229.0	272.7	111.5	1.8	11.5	No	Yes	No	No	.....
Methyl chloride	CH_3Cl	2	No*	Slightly	8–17	95.5	20.9	−10.7	−144.0	289.6	148.7	1.3	6.1	No	Yes	No	Zinc, alum	None
Sulphur dioxide	SO_2	2	Yes	No	None	66.5	11.8	14.0	−98.9	314.8	143.1	1.4	9.1	Some	No	No	Most metals	Flowers, some dyes
Water	H_2O	†	No	No	None	0.62	0.02	212	32	706.0	1007.3	0.2	2288.0	No	No	Yes	.....	None

[1] AMERICAN STANDARD SAFETY CODE FOR MECHANICAL REFRIGERATION—Divides refrigerants into three groups: Group 1—may be used with minor limitations, in institutional, public assembly, residential, commercial, and industrial occupancies; Group 2 may be used, with strict limitations, in the same occupancies; Group 3 may be used only in residential, commercial and industrial occupancies, in unit systems containing not more than 6 lb. † Code doesn't list water as refrigerant but it is probably safest. * Considered anesthetic. ** Underwriters recommend adding odorant such as spearmint. ‡ Pure anhydrous ammonia attacks copper, but in actual practice seems to give no trouble. ‡ Action continues only when oxygen is present.

HEATING & AIR CONDITIONING

A HEATING SYSTEM must replenish heat lost from the building during cold weather while maintaining a comfortable temperature inside. Common assumptions include an outside temperature 10 to 15 F above the local record low, a wind of 15 miles per hr and a ground temperature of 45 to 50 F.

Problem: A wall exposed to 10 F outside and 70 F inside is 12-in. brick, plus ½-in. plaster. Net wall area (minus windows) is 450 sq ft. Windows total 90 sq ft. Total length window cracks is 150 lineal ft. Figure hourly heat loss for this wall, given the following coefficients in Btu per hr per degree temperature difference: Wall, 0.34 per sq ft; window, 1.13 per sq ft; crack, 0.69 per lineal ft (for infiltration).

Temperature difference is 70 F−10 F=60 F. Brick-wall loss is $450\times60\times0.34=9180$ Btu per hr. Window loss is $90\times60\times1.13=6102$ Btu per hr. Crack loss is $150\times60\times0.69=6210$ Btu per hr. Total is 21,492 Btu.

For summer cooling the method is similar, but the heat flows are inward rather than outward.

Because of space limitations these comments can give no more than a general idea of the procedure in figuring heat loss or gain. For detailed tables, formulas and explanations see the *Guide* published annually by the American Society of Heating and Ventilating Engineers, 51 Madison Ave, New York City.

Degree Days

While heating systems must be designed to meet cold-weather conditions, estimates of monthly and seasonal consumption of fuel or steam must be based on average outdoor temperatures, best expressed as *degree days*. If the average temperature for a given day is less than 65 F, the degree days for that day are 1×(65−average temperature). If the average temperature for a month of 30 days is 40 F, the degree days for the month are $30(65-40)=30\times25=750$.

Experience shows that the heat loss (and hence the normal steam and fuel consumption) of a given building should be almost in exact proportion to the degree days.

Problem: In a certain season and in a certain city, the degree days were 865 in January and 465 in March. Past performance with a certain building, when carefully operated, had shown 0.12 tons coal consumption per degree day. Taking this as a standard of good operation what should the coal consumption be in the given January and March?

January burning would be $865\times0.12=103.8$ tons.

March burning would be $465\times0.12=55.8$ tons.

Degree-day data (including summer-cooling data) for all parts of the U. S. can be found in the *Degree-Day Handbook*, published by the Industrial Press, 148 Lafayette St, New York City. Every engineer responsible for industrial or institutional heating should regularly reduce his monthly and seasonal fuel consumption to a degree-day basis to permit honest comparisons.

Air Conditioning

Today heating is often merely one important part of a larger job known as *air conditioning*. Complete air conditioning includes heating, cooling, moistening, drying and cleaning of the air. In all air-conditioning work the following three temperatures are of vital importance:

Dry - bulb temperature (DB) is the actual air temperature as read by an ordinary thermometer with a dry bulb.

Wet - bulb temperature (WB) is the reading of a thermometer with its bulb covered with wet gauze. Unless the air is saturated with vapor the evaporation of water from the gauze will cool the WB below the DB.

Dewpoint temperature (DP) is not any actual temperature of the air, but is the temperature to which the particular sample would have to be cooled to attain 100% humidity (saturation), the condition at which the vapor would start to condense as dew.

If any two of the three foregoing temperatures are known the condition of the air is completely fixed, so the other temperature can be found, also all other properties of the air. These include:

Moisture content—grains vapor in mixture per lb dry air in mixture.

Sensible heat—Btu per lb dry air required to heat the dry air from zero F to the given (dry-bulb) temperature. Roughly it is 0.24×DB temperature.

Latent heat—Btu per lb dry air required to produce the vapor in the air from liquid water. This is about 1050 Btu per lb of vapor, or 0.15 Btu per grain of vapor.

Total heat—Sum of latent heat and sensible heat.

Relative humidity—Grains of moisture per cu ft of mixture, expressed as a percentage of the maximum grains of moisture 1 cu ft of mixture could hold at the given dry-bulb temperature.

Psychrometric Chart

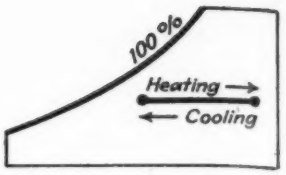
Air-conditioning problems are most conveniently solved with the help of a *psychrometric chart*, obtainable in various forms. That shown is reduced by permission of the copyright holders, General Electric Company (Air Conditioning and Commercial Refrig Dept), Bloomfield, N. J.

Any point on the chart represents air under a single set of conditions. These properties are determined by the lines crossing the selected point, as follows:

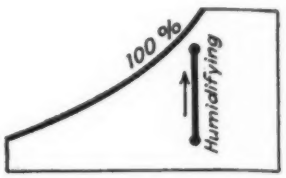
Dry-bulb temperatures—vertical lines.

Wet-bulb temperatures—straight lines of moderate slope.

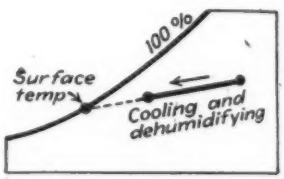
Specific volume (*cu ft per*



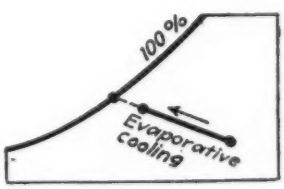
SENSIBLE HEATING OR COOLING is a horizontal line between starting and finishing dry-bulb temperatures. No change in moisture, dewpoint



HUMIDIFYING without dry-bulb change is a line between moisture-content limits. Relative humidity wet bulb, dewpoint and total heat increase



COOLING, DEHUMIDIFYING is a line drawn part way from initial point to cooling-surface temperature on 100% line. All properties change



EVAPORATIVE COOLING washes air with water of same WB as air. Move left along WB line. No change in WB or total heat. DB falls. DP rises.

lb dry air)—steep straight lines.

Relative humidity—curves sweeping up to right.

If any two of these are known their intersection fixes the point at which all the other properties can be read by the lines crossing there.

To read the *dewpoint* move horizontally left from point representing the given air to the marginal curve marked 100% humidity (the saturation line). There the dewpoint is read by the same markings as are used to label the wet-bulb temperature lines.

Total heats depend only on the wet-bulb temperatures, so the wet-bulb lines are extended to a scale reading total heat directly in Btu per lb dry air.

It is very important that the engineer be able to read the chart. Following is an example for practice:

Problem: Given 95 F dry bulb and 40% relative humidity (point B) find other properties.

They are:
Wet bulb, 75 F
Moisture, 99 grains
Dewpoint, 67 F
Specific vol, 14.29 cu ft
Total heat, 38.35 Btu
Vapor pressure, 0.33 psi.

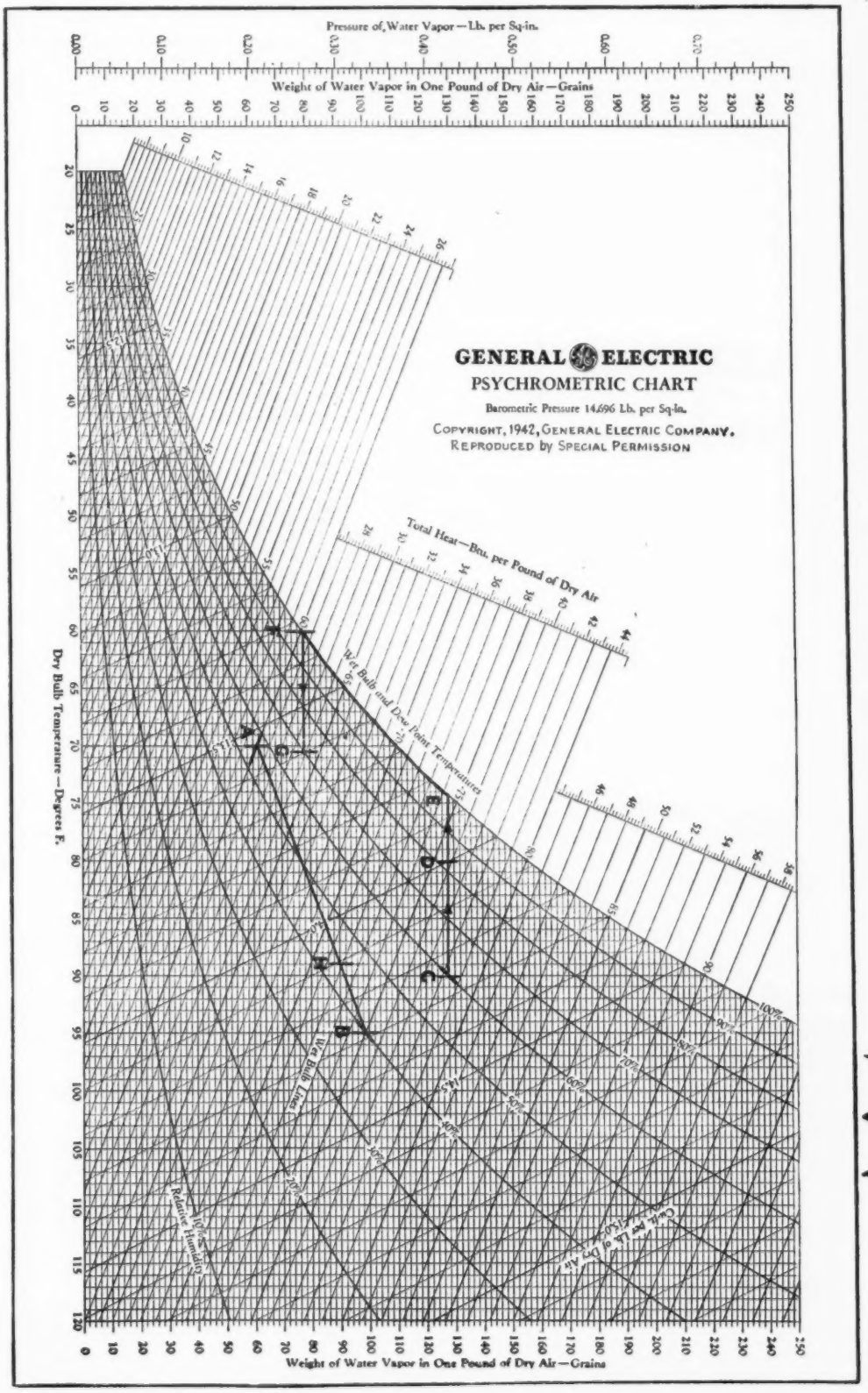
Any conceivable change in air condition can be traced on the psychrometric chart, which can therefore picture all the changes that take place in heating and cooling coils, washers, mixers, ducts, rooms, etc. One example, selected at random and not intended as a commercial operation, is represented by the lines *CDEFG*. Here *C* is the initial condition of the air and *G* the final. At the start (*C*) dry bulb is 90 F and relative humidity 60%. Cool air to 80 F (*D*) without change of moisture. This must be a horizontal movement to the left. At *D* relative humidity is 83% and wet bulb is 75.8 F.

Now continue cooling air until moisture starts to condense. This will carry it horizontally left to the 100% humidity line. Here both dry bulb and wet bulb are 74.3 F, exactly the same as the dewpoint. Note also that *C*, *D* and *E* all have a dewpoint of 74.3 F. At any humidity less than 100% the wet bulb is always higher than the dewpoint and lower than the dry bulb.

Next cool the air to 60 F dry bulb (*F*). The condition will move down the saturation line, remaining 100% humid while the actual water content falls from 129 grains to 78 grains as the difference condenses out. At *F* wet bulb, dry bulb and dewpoint are all equal (all 60 F).

Finally heat the air to *G* without change of moisture. The condition moves horizontally to the right. Dewpoint stays constant at 60 F. Dry bulb rises to 71 F. Wet bulb rises to 64 F. Relative humidity falls to 70%.

The effect of mixing vari-


Pressure of Water Vapor—Lb. per Sq-in.
Weight of Water Vapor in One Pound of Dry Air—Grains
GENERAL ELECTRIC
PSYCHROMETRIC CHART
Barometric Pressure 14.696 Lb. per Sq-in.
COPYRIGHT, 1942, GENERAL ELECTRIC COMPANY.
REPRODUCED by SPECIAL PERMISSION
Total Heat—Btu. per Pound of Dry Air
Wet Bulb and Dew Point Temperatures
Dry Bulb Temperature—Degrees F.
Wet Bulb Lines
Relative Humidity
Cubic Feet per Lb of Dry Air
Weight of Water Vapor in One Pound of Dry Air—Grains

ous proportions of air at two different conditions is represented on the psychrometric chart by a straight line connecting the two conditions. The resulting air always lies on this line. To get the actual point, figure the dry-bulb temperature of the mixture as the weighted average of the dry bulbs of the two original conditions.

Problem: What will be final condition of a mixture of 3000 cfm of A (point A on chart) and 9000 cfm of B?

Dry bulb of *A* is 70 F and of *B* is 95 F. Get weighted-average dry bulb as follows:

$3000 \times 70 = 210{,}000$

$9000 \times 95 = 855{,}000$

$1{,}065{,}000 \div (3000 + 9000) = 89$ F, the weighted average dry-bulb temperature. Then final air condition will be point *H* where the vertical 89-F dry-bulb line crosses the line *AB*.

Problem: How much heat would have to be supplied by conditioning equipment to convert 7000 lb of air from condition A to condition B?

From the chart the gain in total heat per lb is 38.6 Btu—26.6 Btu=12.0 Btu per lb. The total heat supplied is $7000 \times 12.0 = 84{,}000$ Btu.

Sketches at the side of page 92 are based on the GE psychrometric chart. There are many others for which space cannot be found here, so this article should be looked upon merely as an introduction to air conditioning to be followed by a study of the material in such books as the ASHVE *Guide*.

CORRECTIONS, PART 1

Power Handbook, Part I (Dec POWER, 1943) requires corrections in two illustrative problems:

On page 73, last col, discard Fig 16 and its computation, for motor output is erroneously shown greater than input.

On page 81, in problem at top of column, enthalpy should be 1181.5 Btu and final temperature somewhat less than 300 F.

SELECTED HEAT TRANSMISSION COEFFICIENTS

Abstracted from Chapter 3, ASHVE Heating, Ventilating and Air Conditioning Guide, 1941. Reprinted by permission

TABLE 3. COEFFICIENTS OF TRANSMISSION (*U*) OF MASONRY WALLS

Coefficients are expressed in Btu per hour per square foot per degree Fahrenheit difference in temperature between the air on the two sides, and are based on a wind velocity of 15 mph.

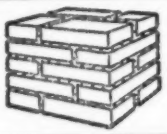
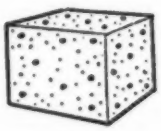
TYPICAL CONSTRUCTION	TYPE OF WALL	THICKNESS OF MASONRY (INCHES)	UNINSULATED WALLS: Plain walls—no interior finish (A)	Plaster (½ in.) on walls (B)	Plaster on wood lath—furred (C)	Plaster (⅜ in.) on metal lath—furred (D)	Plaster (½ in.) on plasterboard (⅜ in.)—furred (E)
	**Solid Brick** Based on 4-in. hard brick and the remainder common brick.	8	0.50	0.46	0.30	0.32	0.30
		12	0.36	0.34	0.24	0.25	0.24
		16	0.28	0.27	0.20	0.21	0.20
	**Concrete (Monolithic)** These figures may be used with sufficient accuracy for concrete walls with stucco exterior finish.	6	0.79	0.70	0.39	0.42	0.39
		10	0.62	0.57	0.34	0.37	0.34
		16	0.48	0.44	0.29	0.31	0.29
		20	0.41	0.39	0.27	0.28	0.27
	Cinder (Monolithic) Conductivity $k = 4.36$	6	0.46	0.43	0.29	0.30	0.29
		10	0.33	0.31	0.23	0.24	0.23
		16	0.22	0.22	0.17	0.18	0.17
		20	0.19	0.18	0.15	0.15	0.15
	Burned Clay aggregate (Monolithic) Conductivity $k = 3.96$	6	0.44	0.41	0.28	0.29	0.28
		10	0.30	0.29	0.22	0.23	0.22
		16	0.21	0.20	0.16	0.17	0.16
		20	0.17	0.17	0.14	0.14	0.14

TABLE 11. COEFFICIENTS OF TRANSMISSION (*U*) OF VARIOUS TYPES OF FLAT ROOFS COVERED WITH BUILT-UP ROOFING

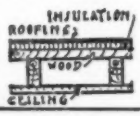
TYPICAL CONSTRUCTION WITH METAL LATH AND PLASTER CEILINGS	TYPE OF ROOF DECK	THICKNESS OF ROOF DECK (INCHES)	WITH METAL LATH AND PLASTER CEILINGS: No Insulation (I)	Rigid Insulation (¾ in.) (J)	Rigid Insulation (1 in.) (K)	Rigid Insulation (1½ in.) (L)	Rigid Insulation (2 in.) (M)	Corkboard (1 in.) (N)	Corkboard (1½ in.) (O)	Corkboard (2 in.) (P)
	Wood	1	0.32	0.21	0.16	0.13	0.11	0.15	0.12	0.10
	Wood	1½	0.26	0.19	0.15	0.12	0.10	0.14	0.11	0.095
	Wood	2	0.24	0.17	0.14	0.11	0.097	0.13	0.11	0.092
	Wood	4	0.18	0.14	0.12	0.10	0.087	0.11	0.096	0.082

TABLE 10. COEFFICIENTS OF TRANSMISSION (*U*) OF CONCRETE FLOORS ON GROUND

Coefficients are expressed in Btu per hour per square foot per degree Fahrenheit difference in temperature between the ground and the air over the floor, and are based on still air (no wind) conditions.

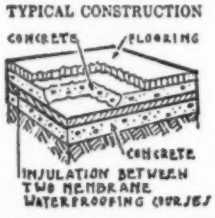
TYPICAL CONSTRUCTION	TYPE OF FINISH FLOORING: THICKNESS OF CONCRETE (INCHES)	No Flooring (Concrete Bare) (A)	Yellow Pine Flooring on Wood Sleepers Resting on Concrete (B)	Maple or Oak Flooring on Yellow Pine Sub-Flooring on Wood Sleepers Resting on Concrete (C)	Tile or Terrazzo on Concrete (D)
	4	1.07	0.35	0.28	0.98
	6	0.90	0.33	0.27	0.84
	8	0.79	0.32	0.26	0.74
	10	0.70	0.30	0.25	0.66
TYPE AND THICKNESS OF INSULATION		A	B	C	D
None					

TABLE 13. COEFFICIENTS OF TRANSMISSION (*U*) OF DOORS, WINDOWS, SKYLIGHTS AND GLASS WALLS

Coefficients are based on a wind velocity of 15 mph, and are expressed in Btu per hour per square foot per degree Fahrenheit difference in temperature between the air inside and outside of the door, window, skylight or wall

A. Windows and Skylights

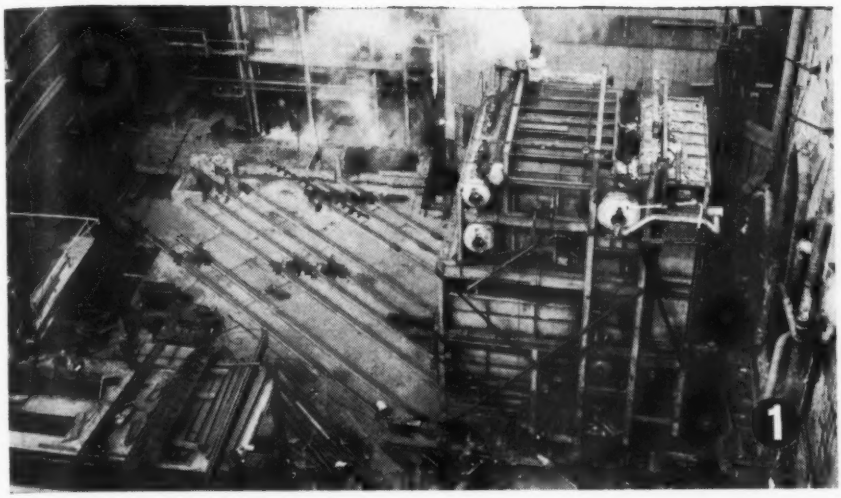
DESCRIPTION	*U*
Single	1.13
Double	0.45
Triple	0.281

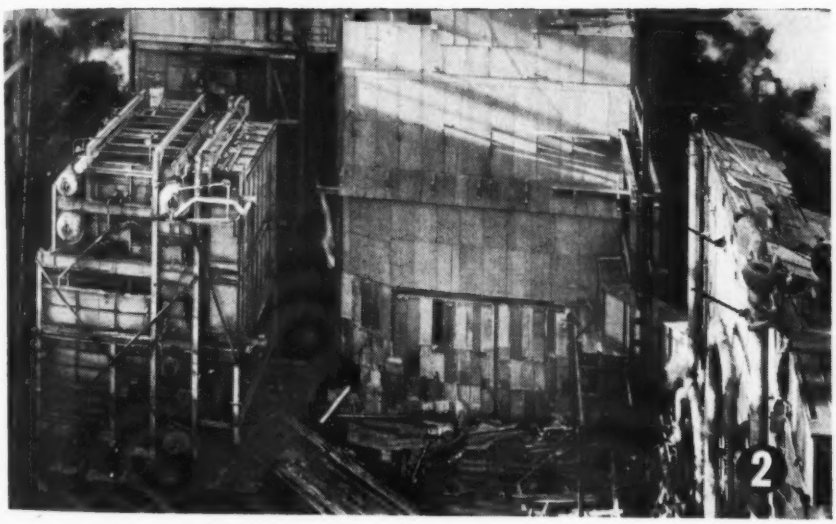
B. Solid Wood Doors

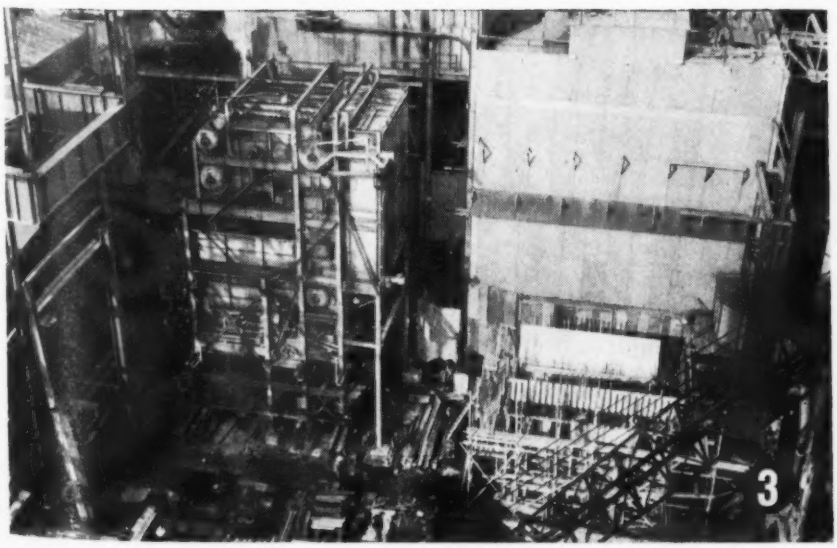
NOMINAL THICKNESS INCHES	ACTUAL THICKNESS INCHES	*U* EXPOSED DOOR	*U* WITH GLASS STORM DOOR
1½	1 9/16	0.52	0.35
1¾	1 13/16	0.51	0.35
2 "	1 5/8	0.46	0.32
2½	2 1/8	0.38	0.28

Moving Navy Yard Boiler Saves Four Months and $75,000

By GEORGE F FLAY JR
Spencer, White & Prentis, Inc







► UNDER WAR PRESSURE, engineers search as never before for economies. And so a large engineering company and the Navy used a contractor's special skill and experience to save time, materials and money at the New York Navy Yard.

An important J G White Engrg Corp war project included enlarging existing power facilities at the Yard, while maintaining the old plant at maximum capacity. Several new steam-generating units, installed in the powerhouse extension, were to be supplemented by an existing Riley boiler which had operated for two years in the old plant. To fit this unit into the new layout meant moving it 78 ft 1 in. horizontally and 10 ft 11 in. vertically.

Standard practice in such a relocation involves careful dismantling and assembling in the new spot. In addition to dismantling and re-erection costs, this meant a minimum replacement of 25% of water tubes and 100% of brick, welding all tubes cut and replacing certain unsalvageable parts. Cost estimates came to $110,000 and time required to six or seven months, assuming no delays in securing tubes and unsalvageable parts.

The general contractor and the officer-in-charge believed that great savings could be made by moving the boiler as a unit and called in Spencer, White & Prentis, Inc, to check their estimates and prepare preliminary plans. The writer, engineer assigned to the job, visited the boiler manufacturers to discuss the feasibility of the proposed method of handling. All agreed the project was feasible and showed a saving of about $75,000 and at least four months' time over dismantling and rebuilding. Accordingly, Spencer, White & Prentis

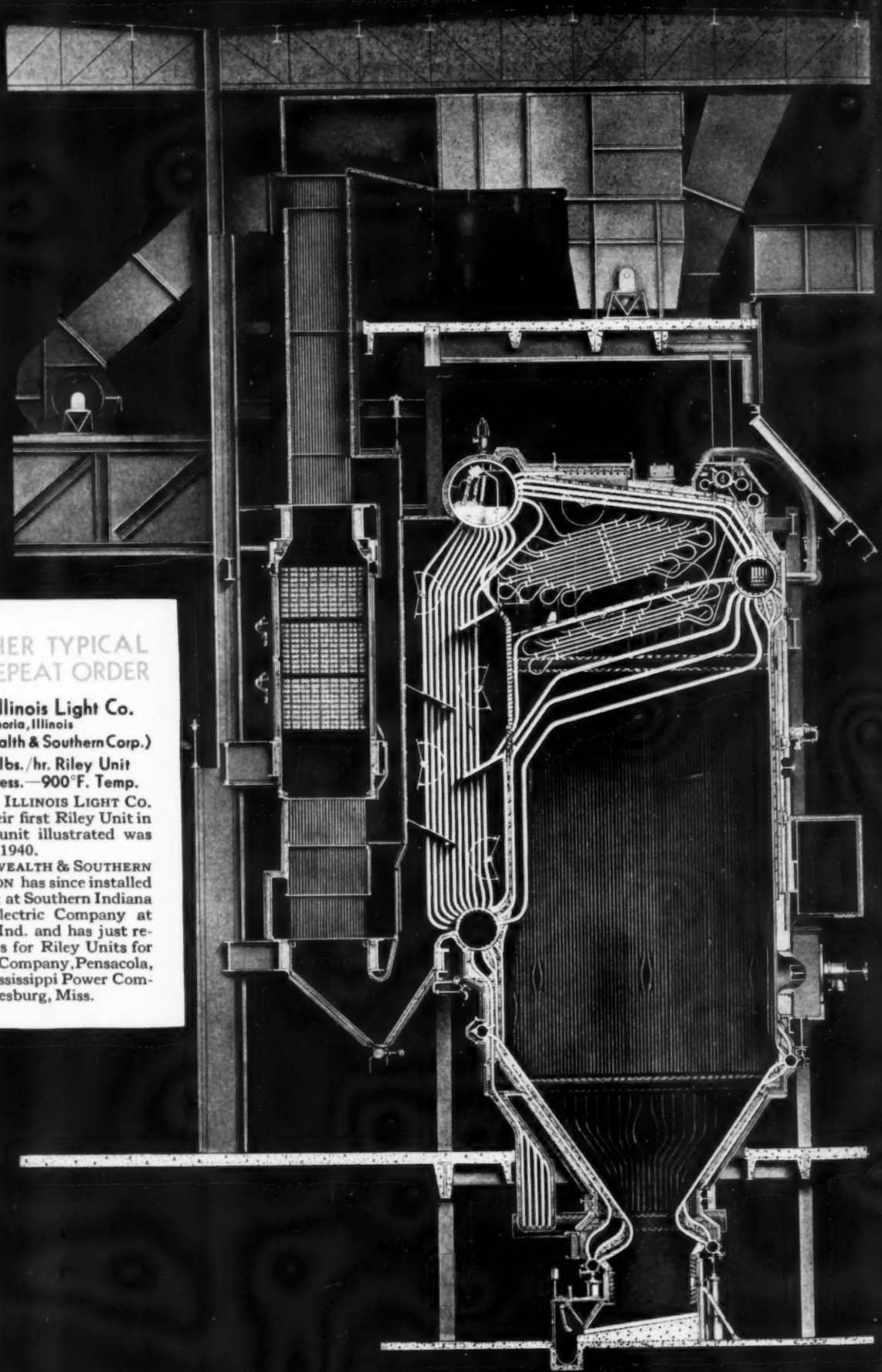
(*Continued on page* 98)

1—Start of horizontal move; boiler in old location, track system of nine double lines of rail in place

2—End of horizontal move. Note beams welded to boiler skeleton to carry load formerly on concrete sidewalls and supporting pipe columns

3—Boiler in final position after vertical lift. See picture on page 98 for details of lifting method

The Regularity with which Riley



ANOTHER TYPICAL
RILEY REPEAT ORDER

Central Illinois Light Co.
Peoria, Illinois
(Commonwealth & Southern Corp.)

375,000 lbs./hr. Riley Unit
900 lbs. Press.—900°F. Temp.

CENTRAL ILLINOIS LIGHT CO. installed their first Riley Unit in 1937. The unit illustrated was installed in 1940.

COMMONWEALTH & SOUTHERN CORPORATION has since installed a Riley Unit at Southern Indiana Gas and Electric Company at Evansville, Ind. and has just released orders for Riley Units for Gulf Power Company, Pensacola, Fla. and Mississippi Power Company, Hattiesburg, Miss.

Users Repeat with more Riley Units

tells a significant story to purchasers of steam generating units

Riley Boiler users have, with gratifying regularity, repeated for more Riley Units when installing additional steam generating units. The accompanying tabulation lists but a few of the companies which have repeatedly placed orders for Riley Units. This preference, this refusal to accept something almost as good, by Riley users, tells a significant story of the satisfactory performance of Riley Steam Generting Units.

Users know well the operating advantages of Riley Units—their ability to operate at high capacity over long periods of time, without shut down; their high sustained efficiency; their negligible maintenance and trouble-free operation. Operating advantages resulting from the many distinctive design characteristics of Riley units.

The large number of repeat orders representing more than half of all Riley business, together with the great swing to Riley by companies installing Riley units for the first time, have boosted Riley sales to such an extent that 1942 sales were over fifteen times sales in 1931 and almost five times sales in 1937.

This record of users repeatedly ordering Riley Steam Generating Units tells a conclusive story of unusually satisfactory results.

A LARGE MAGNESIUM COMPANY
6 orders—11 Riley Units

A LARGE CHEMICAL COMPANY
6 orders—14 Riley Units

A LARGE AIRCRAFT MANUFACTURER
9 orders—14 Riley Units

A LARGE OIL REFINING COMPANY
7 orders—11 Riley Units

A LARGE PUBLIC UTILITY
5 orders—5 Riley Units

A LARGE RAYON MANUFACTURER
5 orders—8 Riley Units

A LARGE STEEL CORPORATION
5 orders—7 Riley Units

A LARGE PAPER COMPANY
6 orders—8 Riley Units

AN EASTERN OIL REFINING COMPANY
4 orders—4 Riley Units

A LARGE NATIONAL MILK COMPANY
9 orders—9 Riley Units

A LARGE MEAT PACKER
4 orders—4 Riley Units

A LARGE TEXAS OIL REFINERY
6 orders—10 Riley Units

A PRESDWOOD COMPANY
4 orders—7 Riley Units

A LARGE PUBLIC UTILITY SERVICE CO.
5 orders—6 Riley Units

A TAR AND CHEMICAL COMPANY
4 orders—4 Riley Units

RILEY

STOKER CORPORATION, WORCESTER, MASS.

BOSTON NEW YORK PHILADELPHIA BUFFALO CLEVELAND DETROIT SEATTLE WASHINGTON
ST. LOUIS CINCINNATI HOUSTON CHICAGO ST. PAUL KANSAS CITY LOS ANGELES ATLANTA

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Moving Navy Yard Boiler Saves Four Months and $75,000

(*Continued from page 95*)

received a lump-sum contract for the job.

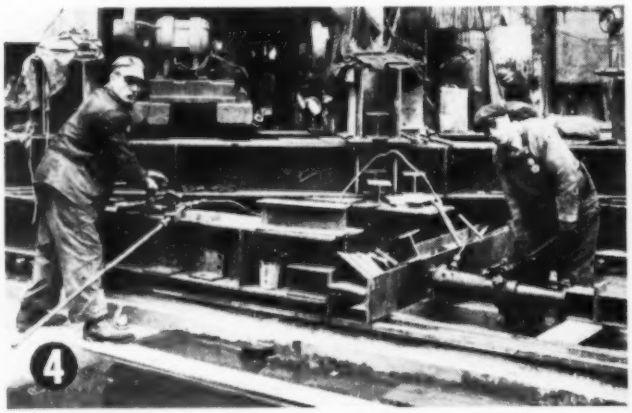
In the old power plant, the boiler rested on a 30-in.-thick concrete slab, supported by wood piles. It covered an area 25 ft 6 in. by 33 ft 8 in. and rose 52 ft 8 in. above the concrete. Approximately 600 tons of its weight rested on ten structural columns, arranged in two rows of five each, parallel to the longer dimension. This part of the weight consisted of four drums, waterwall and boiler tubes, superheater, headers, economizer, casing and steel skeleton, and most of the brickwork. Remaining weight rested on four steel beams supported by concrete and masonry walls and lolly columns bearing directly on the concrete mat, and consisted of stoker mechanism and grates, a small part of the brickwork and lower headers. Transferring load from the concrete sidewalls and the pipe columns to steel beams welded to the boiler skeleton made it possible to move the boiler as a unit.

The track system consisted of nine double lines of 100-lb AREA rails, all carefully set to the same elevation and grouted in place. Runner beams with bearing plates were next set in position beneath the boiler. Distributing beams, one on either side of the two rows of boiler columns, were placed on the runners and a pair of needle beams welded in place, bearing directly on the distributing beams. This arrangement provided a rigid carrying frame with all pieces at the same relative elevation.

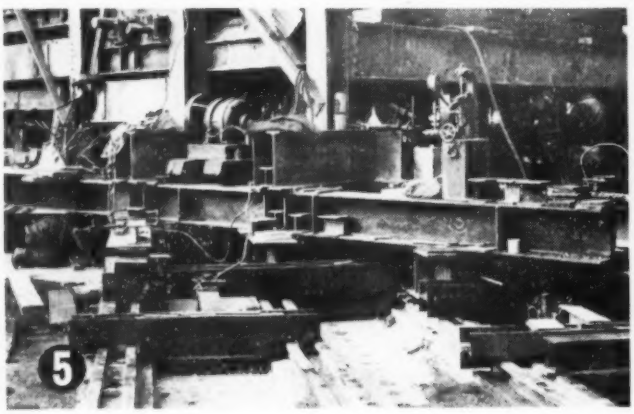
Jacking Arrangements

Jacks placed at strategic locations beneath the distributing beams raised the boiler 2 in., making space for rollers. After lowering the boiler on the rollers, horizontal jacking moved it to the new location. After column extensions were spliced on and additional needle beams welded to the extensions, jacks placed beneath the needle beams started the vertical lift. Raising required three days; then temporary steel was removed, billet plates set beneath columns, pedestals poured and plates dry-packed in place.

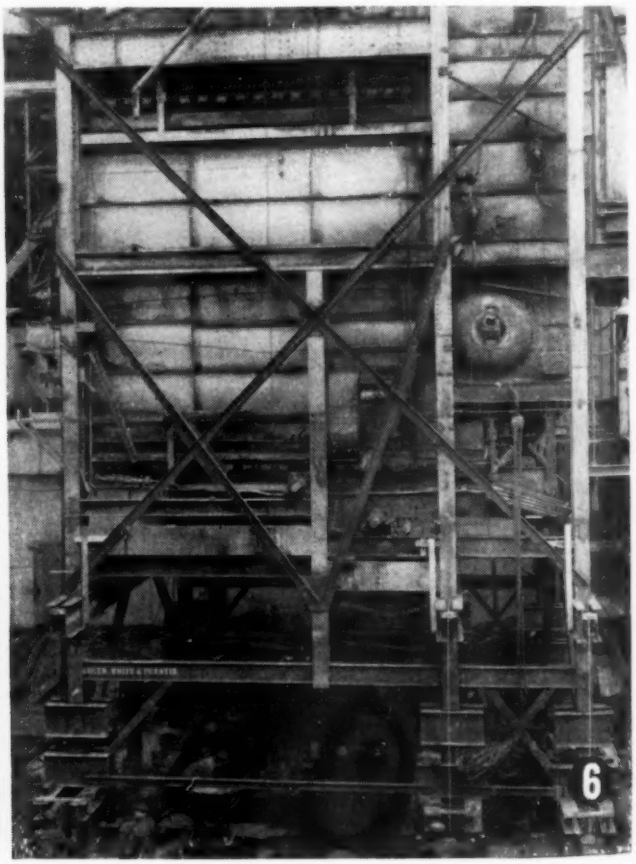
Boiler relocation was executed for the U. S. Navy, Bureau of Yards and Docks: Rear Adm Ben Moreell, chief of bureau; Capt John J Manning, director of construction; Capt W M Angus, public works officer; Comdr H C Griswold, officer in charge; Howard Keil, asst; and W Ireland, job inspector. General contractors were J G White Engrg Corp: C A McCullough, job mgr; John Boardman, job supt; Messrs Gruner, Warren and Malone, assts. The engineering staff of Spencer, White & Prentis, Inc, relocation contractor, developed the technique of raising and moving and, in addition, designed the necessary structural parts: J C Weaver, genl supt; Mike Canale, job supt; and G F Flay Jr, engr in charge.



4 Closeup shows horizontal jacking operation. Workman at left manipulates valve releasing hydraulic fluid from jack; man at right retracts jack before next move starts



5 Another view of horizontal jacking setup. Note H-beams behind jacks; these clamp rails when jack pressure is applied; the greater the pressure, the tighter the grip



6 Closeup of lifting operation. Workmen under boiler operate hand pumps for hydraulic pressure, in unison. Other workmen at each jacking point watch movement closely; keeping safety nuts on the jacks hand tight holds maximum drop to 1/16 in. should hydraulic pressure fail. Extreme care was taken to make lifting uniform and to avoid setting up vibratory movement. Raising required three days

THE OLD CHIEF

GHOSTS

Compared to it, a graveyard at midnight would be cheerful

The Old Chief has a personal and very poignant experience when he revisits The Bumner to view and make an offer for some light conveyors. Another in the series by William Doran, chief engineer, Essex Co Sanatorium, Windsor, Ont.

BEFORE COMING TO WORK FOR THE OLD CHIEF I had spent all my days in the town of Kempers, a quiet little place that lies about 20 miles south of the Old Plant. The only factory of any size in the place was known as The Bumner Manufacturing Company. I had an uncle who worked there and during my high-school days I could always find much needed employment at the plant during the summer vacations.

In those days the factory was a hustling, bustling hub of activity. My particular job usually consisted of moving heavy boxes from one place to another or of helping the carpenter make packing cases. I confess that I liked working better than school. The boys and girls of my own age who worked there were a grand bunch to get along with. I enjoyed the companionship of the former and was not immune to the smiles of the latter.

After I left school and started on my long association with the Old Chief, I often heard bits of gossip about *The Bumner*, as we called it. Mr Bumner himself had passed on. I remember him as a dignified, handsome man with a full black beard. The place had been sold to a group, who in turn had sold out to a company, who merged with another company, and so on. The name on the office door changed many times, but to this day the locals call it The Bumner.

About 1907 our family moved away and for a long time I heard nothing about it, except that now and again I would see something in the papers about this or that group entering pleas in the law courts to establish ownership or to recover the property.

Once in a long while some of my old school chums would come to work in our plant and from them I would hear stories of the "decline and fall" of The Bumner. A tight-fisted management had cut wages to the bone and the place was falling into rack and ruin. The old staff had either been fired or had quit and were replaced with cheaper men. The chief engineer had refused to light a boiler until he was given materials to rebrick the front arch in one of the boilers. He was fired. The next man ran into a steam-fitting job one Saturday afternoon. Finding no one in the office, he drove to town and secured a bag of fittings and worked half the night to repair the job. His reward was to be fired for making purchases without the consent of the manager. Another engineer had no materials to repair a number of breaks in the return line from the factory heating, so he trapped the end of the line to the sewer. He was fired because he used more coal than his predecessor.

The Deserted Village

It must have been about three years later that I drove through Kempers and noticed that the place was closed up. Later, there were rumors that it would reopen but as far as I know it never did. One evening as I was going off duty the Old Chief told me that he was interested in some light conveyors that were lying idle down there, and he had secured permission to view and make an offer of purchase.

"Pack some tools," he ordered, "we'll go down first thing in the morning."

Now all my life I have noticed that when an engineer plans to do something "first thing in the morning" something else is bound to crop up to change his plans. This occasion being no exception, it was later in the afternoon of a very cold, dull winter day when we started for the scene of my youthful endeavors.

We picked up the keys in the town, and found that they opened the engine-room door. Inside, the cold seemed ten degrees lower than outside and we had to make use of our flashlights to see anything. I heard the Old Chief gasp when he saw the condition of the engines. They were Atlas, center crank with automatic cutoff. One drove a dynamo and the other was belted to the line shafting in the factory. I recalled the pride the engineers had taken in the spotless condition of that engine room. Evidently it had become the dumping ground for all the rubbish of the factory. The walls were smudged with grease;

(*Continued on page* 156)

AC Adjustable-Speed Drives Power Underfeed Stokers

I L Nevells, stoker engineer, Westinghouse Electric & Mfg Co, discusses some stoker-drive problems in typical plants and shows how a recently developed ac adjustable-speed drive meets a wide range of operating conditions

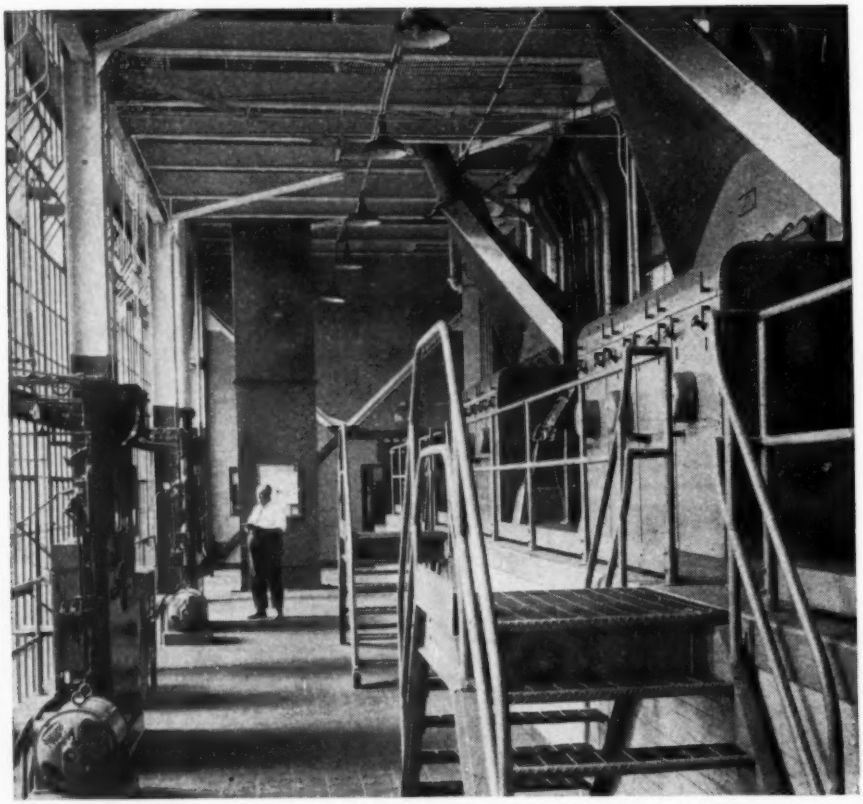


Fig. 1—Model boiler room with totally inclosed underfeed stokers powered by an ac adjustable-speed drive. Compact motor-generator sets for these drives, located near the panelboards, do not require exciters. Motor-speed-control generator-field rheostats on the meter panels are chain operated from the automatic combustion control

► MODERN BOILER OPERATION requires stoker drives capable of a wide range of speed control and good speed regulation. Among the various available arrangements, geared steam turbines, with variable-speed governors, find wide use, particularly where heat-balance conditions make steam drives economical. Where conditions dictate electric drive, choice lies among constant-speed squirrel-cage motors with variable-speed transmission equipment, or various types of ac-dc drives. In this latter group, a recently developed ac adjustable-speed drive offers desirable characteristics. Here's how typical plants solved stoker-drive problems with this scheme:

Large chemical manufacturing plant. Several short dump-grate multiple-retort underfeed stokers were installed under the old boilers and driven by small steam turbo-gearboxes with 4-speed ac-motor auxiliary drives, chain-connected to the stoker lineshafts. Heat balance was such that normally steam drives were used, the motors being reserved for times when turbines were overhauled. When the plant expanded and a new boiler was ordered, its stoker had the same type drive as the old ones but was four feet longer and designed for higher combustion rates.

This arrangement would have been satisfactory but after putting the boiler in operation, exhaust steam was found ample without the stoker turbine drive. So the 4-speed motor was used and steam drive operated in emergencies only. Not having a wide smooth speed range, a 4-speed motor is not adapted for a large underfeed stoker under automatic combustion control. The motors could operate at 1200, 900, 600 or 450 rpm but the steps between these fixed speeds were too great to maintain an even fuel bed and good combustion conditions. By close attention it was possible to operate the boiler fairly satisfactorily but indications were that stoker maintenance was higher than necessary and there was probably some loss in efficiency.

In 1941, a second new boiler was designed for motor drive with emergency steam drive. An ac adjustable-speed drive, which they decided to use, has operated for 18 months without change, except in minor details to meet minimum speed requirements, and has eliminated the undesirable conditions associated with the 4-speed-motor drive.

Eastern public utility plant. Two stokers were installed and driven by constant-speed motors through variable-speed transmissions. Their infinitely variable 6-to-1 speed range met all requirements. When two more stokers were purchased, their fronts were inclosed in dust-tight housing for cleanliness because boilers and turbo-generators were installed in the same room. Stoker-drive motor and transmission dimensions would not permit installation inside the stoker housing, and outside they required too much floor space. An ac adjustable-speed drive with a wider speed range in the available space cost only slightly more than the older drive. Motor speed on this job, controlled by a sprocket-operated rheostat with 180 contact points actuated by automatic combustion control, changes stoker speed as required by the fuel-air ratio for any steam load.

An ac adjustable-speed drive consists of a polyphase squirrel-cage motor driving a series-wound dc generator, mounted on the same shaft, supplying current to a series-motor driving the load, as in Fig. 3. The motor generator of the barrel-frame design operates at 1750 rpm. Only control equipment is a simple across-the-line starter with low-

voltage and overload protection. The drive motor, a standard series dc design, has its speed controlled by a shunt rheostat across the generator field winding. Since the generator's voltage decreases with a decrease in load, the series motor cannot overspeed at light loads.

This drive combining conventional electrical units in a new arrangement is easy to operate and maintain. Pushing a button closes the ac-motor-starter contactor and starts the motor-generator. As it comes up to speed, the series motor starts and accelerates to a speed corresponding to the setting of the generator's field rheostat. Speed of the series motor may be changed by simply varying the resistance of the field rheostat, which varies the voltage output of the series generator. Once the series-motor speed has been set, any load increase or decrease causes a corresponding increase or decrease in the generator field current, because generator- and motor-field windings are in series. This change in generator field current raises or lowers generator voltage, thus tending to maintain constant motor speed.

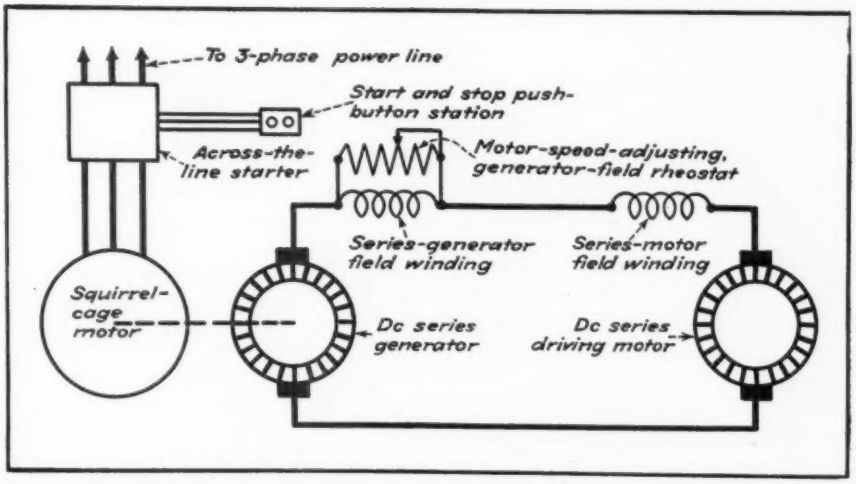


Fig. 3—In this schematic diagram, an ac adjustable-speed drive consists of a standard squirrel-cage motor, driving a series generator to supply power to a standard series motor. Speed of the latter can be adjusted from practically standstill to maximum by a rheostat in parallel with the generator field winding. Because generator voltage decreases when load decreases the series motor cannot overspeed at light loads

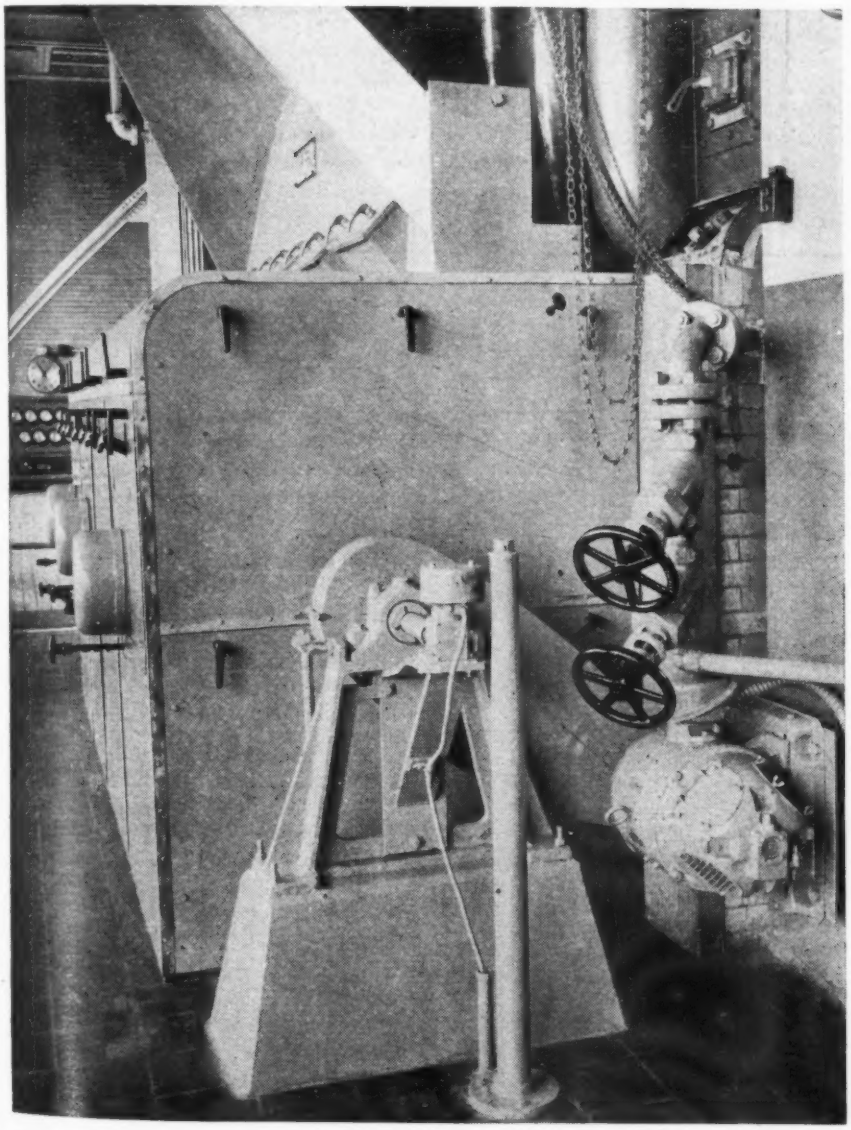


Fig. 2—Dc series motor of an ac adjustable-speed drive mounted on boiler column connects to totally inclosed stoker drive shaft by an inclosed silent-chain drive

A range of 10 to 1, 1750 to 175 rpm, is the usual limit and is stable for any speed setting particularly below 1200 rpm, as shown by the speed-torque curves, Fig. 4. For example, the speed at 1000 rpm remains practically constant between 10 and 150% load and, at 600 rpm, holds practically constant between 25 and 175% load. The speed-control rheostat across the generator-field winding may be adjusted manually or automatically as, for instance, by automatic combustion control when the drive is on a stoker.

Boiler plant's summer and winter operation. Where a low continuous load requires a speed below the standard limit of the drive, it may be had by connecting a small amount of resistance in series with the generator field winding. With this type of drive and automatic combustion control a plant's summer operation called for a speed below standard. By connecting a small coil of wire in series with the generator-field winding, the operator got a motor speed of 21 rpm which was too low for minimum requirements. Then, by trial and error he cut out portions of the coil until he obtained the desired minimum speed. In the fall, when the heating load picked up, he removed the coil and operated on the motor's standard range.

Range in various plants. Required speed range for stoker drives depends on upper and lower steam-load require-

ments. A 4-to-1 range may be adequate for the average industrial or utility boiler plant, whereas a municipal plant or heating load may require a 10-to-1 speed range. In general, speeds lower than those obtained with a 10-to-1 range to operate stokers continuously are of little importance. The fire is practically banked at such low ratings; consequently, the stoker can be operated intermittently without detrimental effect on performance or maintenance.

Wide Speed Range

Exceptions are a continuous light summer load of steam-driven units and a heavy winter heating load. Here the stoker drive would have to meet the requirements of both loads, but the ac adjustable-speed drive can be readily adapted to meet these conditions, as previously explained. Increments of speed change between upper and lower limits should be as small as is consistent with good mechanical construction. For large stokers and high combustion rates it is especially important to match closely coal feed and air flow. Speed must be stable for any setting of the controller, which must be designed to operate by automatic-combustion control.

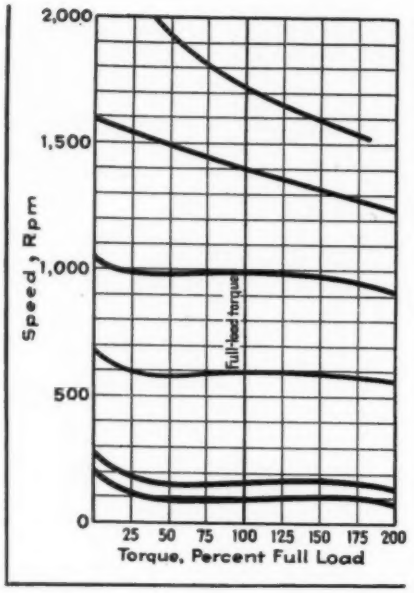


Fig. 4—Typical speed-torque curves of an ac adjustable-speed drive show wide range and good regulation

An ac adjustable-speed drive can be installed on any multiple-retort underfeed stoker. Follow the stoker manufacturer's recommendations when selecting size of motor and chain drive for connecting to stoker lineshaft. Specify either manual or sprocket operation for the field rheostat as needed.

Where totally inclosed motors were formerly considered necessary, many engineers have used open designs because of war restrictions. Many boiler rooms can use them, but others, where coal or ash-handling methods cause considerable dust in the atmosphere, may profitably use totally inclosed motors. Splash-proof motors may meet the requirements. Base selection on specific requirements of the boiler room where the drive is to be installed. Where steam-and-electric dual drive is desirable, coupling a steam turbine to a shaft extension of the motor generator provides a compact drive at reasonable cost.

The best stoker drive properly installed usually costs less than 1% of the total of the steam-generating unit it serves. In a well operated plant such a drive pays big dividends by insuring highest performance and reliability of boiler and furnace. On the other hand, if the drive is not suited to the job or is incorrectly applied, increase in operating costs may in a short time amount to more than any saving made in the cost of such a drive.

Welding Diesel Jacket Saves $3742

By R C WILSON
Tucson, Arizona

Material submitted to the James F Lincoln Arc Welding Foundation in its recent $200,000 Industrial Progress Award Program for reports on advances in the application of arc welding in design, fabrication, construction and maintenance. The 2½-yr study, in which 408 awards were made, indicated a possible annual saving by arc welding of nearly two billion dollars, including seven million tons of steel, valued at 271 million dollars and 153 million man-hours.

►Tucson Gas Electric Light & Power Co supplies diesel-generated electric power for Tucson and the surrounding country. As a maintenance mechanic and welder for the engines, I am describing repairs we made some time ago on a 3750-hp 6-cyl air-injection 124-rpm Busch Sulzer diesel—bore 30 in., stroke 42 in.

Scaling in the water jacket on No. 4 cylinder retarded water circulation so that the jacket metal overheated and cracked, forcing us to shut down the unit. Jacket is 42 in. diameter, 4 in. thick and 78 in. high. Starting at the extreme top of the jacket, the crack ran straight down for 27 in. To get at it from the inside, we removed the cylinder liner and chipped off all scale.

After completing the usual veeing process, there was a cavity 3 in. wide and 3½ in. deep. We drilled and tapped the surface of the vee for 3-in. studs on 2-in. centers, allowing the studs to extend 1 in. above the surface of the vee.

Because the jacket was of cast iron, we used $\frac{5}{32}$ in. soft weld for our first coating of bond weld, applied with 120 amp, at 40 v. We took care not to overheat the casting. To relieve stress, we peened each bead with a blunt tool and hammer.

After thus coating the entire vee surface with soft weld, we allowed the casting to cool completely before starting the main weld or fill. For this filler, we used $\frac{1}{2}$ in. No. 7 rod, with 140 amp, at 45 v, continuing to peen after laying each bead.

After completing the fill on the inside, we made a surface weld on the outside of the jacket directly over the crack. Then we inserted liner and piston and put the engine back in operation. It has been running steadily since the repair was made with no sign of further leakage.

In figuring the cost of this job, do not include the labor of removing the liner because that would be necessary in any case to get at the scale. Actual welding time on this job was 22 hr for two men, a total of 44 man-hours. We used 9 lb of soft weld rod and 28 lb of No. 7 rod. Costs were about $65 for labor and $43 for material, including welding equipment, making a total of $108 for welding only.

Cost of dismantling the engine, removing the liner and reassembling the engine was about $250 for a six-man crew, making a total cost of $358. By contrast, a new jacket would have cost about $3500, plus $600 in labor and an extended delay in obtaining the desired part. Net saving, therefore, was at least $3742.

Under the circumstances, the arc-welding job was service insurance as well as a money-saver.

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

How Much Shaft Current Can A Bearing Carry Safely?

In spite of theory and experiment, L W Riggs, General Electric Co, says that the practical answer to this question is none. Here is his detailed analysis of the subject, giving the causes of wrecked bearings as well as their prevention

PERHAPS IT IS TRUE that one ampere uniformly distributed over a 100-sq in. bearing surface may not be harmful, but when the shaft rotates who can say with certainty that the current distributes uniformly? Possibly the oil film insulates 99% of this area, forcing that one amp through the remaining 1 sq in.

In some machines the film may be thick enough to virtually insulate the shaft from the bearings and prevent destructive current. With the same shaft voltage in another machine the bearing oil film may not insulate and then trouble soon develops. Well-fitted bearings build up a better oil film than those in which surfaces are not true.

Shaft-end play is also a factor in bearing current. If the shaft collar or shoulder runs free of the bearing ends the oil films in the two bearings are in series and effectively break the current path. If the collar on one end rubs its bearing, only the film in the remaining bearing offers resistance to shaft current flow. As a result, the latter oil film may fail and pass current.

Oil rings may also make contact between shaft and bearing. First signs of trouble at this point often appear as scratches on the shaft under the ring. A rotating ring rubbing its bearing slot makes and breaks the circuit causing a spark that pits the shaft. Therefore, measuring such current by shunting an ammeter across the oil film may give false indications.

The best way to measure current is to connect the ammeter across bearing-pedestal insulation, making sure beforehand that bearing is not grounded. Current is usually alternating, frequently at a greater than line frequency, and so it is necessary to use an ac ammeter.

Shaft voltages occur from various causes: some accidental and others more or less inherent in the machine design. Since changing the design may be ex-

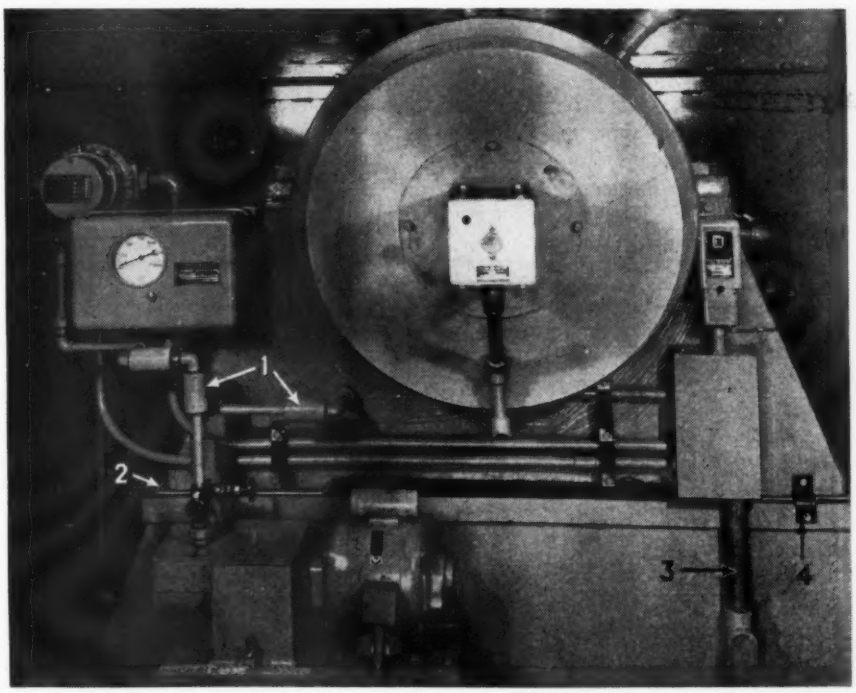


Fig. 1—Perfect insulation (2) gives no protection unless insulating couplings (1) or plastic tubing (3) break metallic circuits. Ground only one bearing (4)

pensive, it has seemed desirable not to spend too much time, effort and money attempting to eliminate shaft voltage, but rather to insulate against current flow across the bearings.

One chief cause of shaft voltage is joints or laps in the stator core that are unsymmetrical with respect to the rotor pole pieces. Consider the 4-pole revolving field machine in Fig. 2. Arrowheads indicate the magnetic-flux paths. If the magnetic circuits are uniform (left) the flux will be equal in each path, consequently equally distributed about the shaft. With joints in the core (center) reluctance through the joints may be considerably higher than through other paths. This unequal flux distribution in the different circuits may cause part of the magnetic field to link the shaft.

Because of this core-joint reluctance magnetic density may be less at points *E* and *F* than at *G* and *H*, and some of the flux from *G* and *H* may take the easier path through *E* and *F* (dotted lines) rather than follow its usual path (solid lines). Stray flux passes from pole *A* to *D*, then to *C* and *B*, and back to *A*, thus encircling the shaft.

Shaft Flux Alternates

Suppose the rotor moves one pole space, the shaft flux decreases to zero and builds up to normal again in the opposite direction and the poles then have the positions at right. Now, core joint is in the flux circuits between poles *A* and *B*, and *C* and *D*. Flux component that links the shaft is from *A* to *B* through *C* and *D* and back to *A*. This varying flux linking the shaft induces a voltage in it just as voltage is induced in a conductor within an ac field, and current will flow when induced voltage overcomes the resistance in its path.

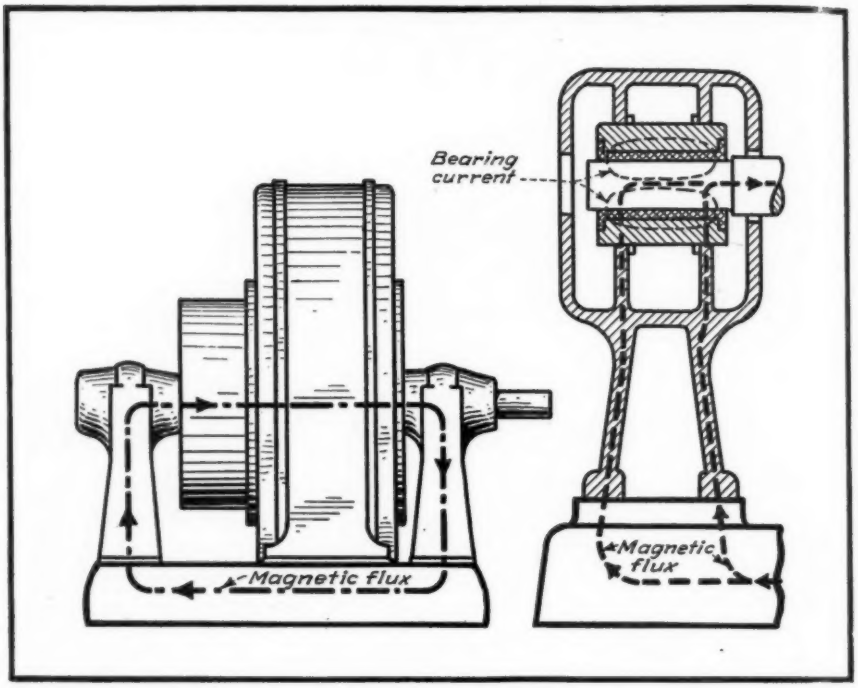


Fig. 3—Magnetic flux flowing through base, bearings and shaft induces voltage in rotating-shaft ends producing a circulating current across each bearing face

Certain rotor ground-protective relay systems have been suspected of causing capacity currents to flow through the oil film, and gradually, over a long period of time, of damaging the journal. The remedy is to discard that particular relay circuit, or put a brush on the shaft to bypass the oil film.

Sometimes a field winding becomes grounded to the rotor and, if another ground exists on the excitation system, a large dc current may flow through the bearings to ground. Any grounded pedestal bearings are likely to suffer damage.

Occasionally a high-potential source becomes connected to the rotor through accident. Such a voltage will go to ground even through good bearing insulation, and damage any or all of the bearings. Such an accident might occur, for example, if some foreign metal object became wedged between the rotor poles and the high-voltage stator-coil winding.

Another possible cause of bearing current is static discharge from belt drive. These charges can pass from the belt to pulley and shaft and from there to the bearings, frame and ground. Repeated discharge through the oil film may pit the shaft and bearings.

One source of bearing current encountered so rarely that it presents con-

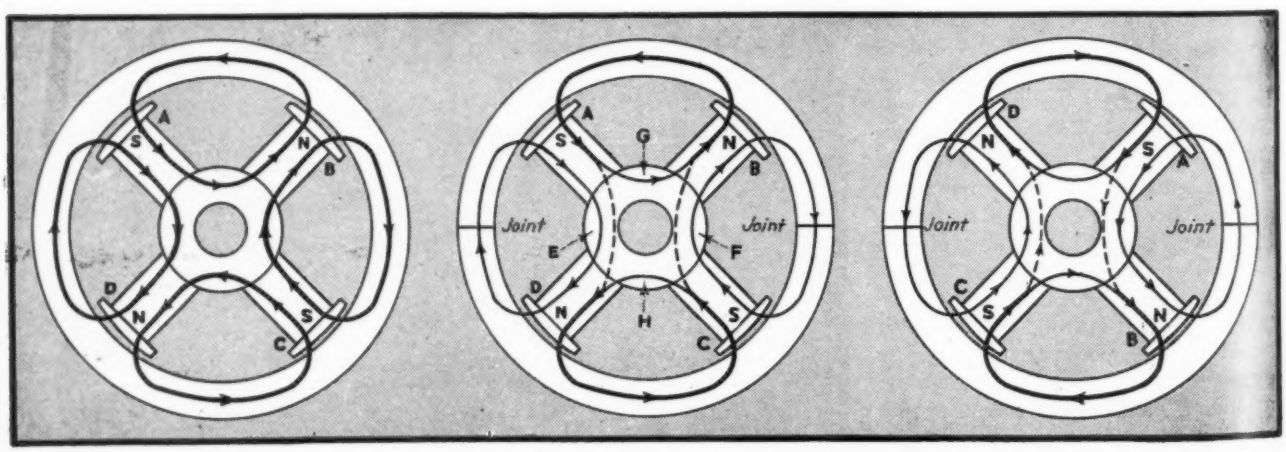


Fig. 2—Stator-core joints increase the reluctance of magnetic circuit and force the pole flux to take another path nearer the shaft. As each oncoming pair of poles span the joint linkage, flux reverses causing induced potential in shaft

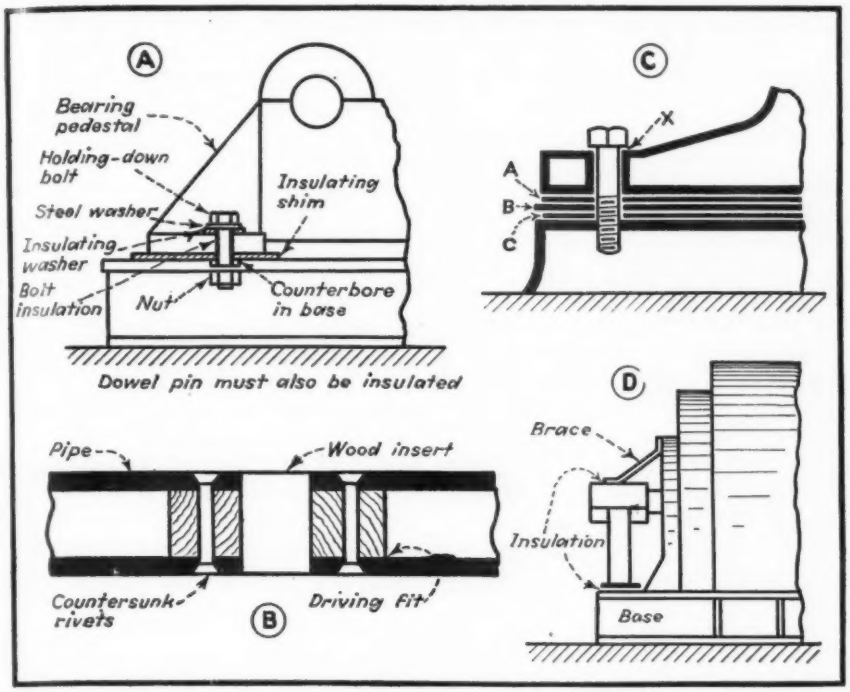


Fig. 4—(A) Pedestal insulated from base; (B) wooden insert breaks metal handrail; (C) sandwich insulation; (D) housing brace must be insulated

siderable of a mystery is found when the shaft becomes heavily magnetized. Magnetic flux may follow along the shaft, through the bearings, pedestals and base, Fig. 3.

As the shaft revolves it cuts this flux causing local currents to flow in each individual bearing. Two remedies are: (1) Substitute a non-magnetic bearing shell, and/or a non-magnetic pedestal. This introduces the equivalent of a large air gap in the magnetic circuit and thus greatly reduces the flux. (2) Place a stationary demagnetizing coil around the shaft, energized from the exciter in a direction to buck down stray magnetic flux. Machines of special design with only one field coil around the shaft inherently have a magnetized shaft.

Evidence of Current

A journal surface that has passed shaft current appears frosted or etched, and in the early stages before wiping occurs, babbitt may be pock-marked. At first, bearing temperature generally rises slowly and should be investigated before trouble occurs. Oil is likely to be discolored and may have an acid reaction. Some authorities believe that oil's acid condition favors bearing-current flow, but the writer does not know of any cases chargeable to this. Certainly if insulation is adequate, oil condition should not have any influence on the current flow, although it might have a detrimental effect on a nicely polished journal and bearing surface.

In the past it has admittedly been a considerable chore to test bearing insulation. Procedure required a shutdown, removal of bearing cap, and raising the shaft out of contact with the solidly grounded bearing while applying a test voltage between shaft and machine base. This tests all insulated bearings at once. If a fault exists each insulated bearing must be isolated in turn and given an individual test.

In recent years some manufacturers insulate all bearings and then ground one of them with a removable copper strap, (4) Fig. 1, or grounding bolt, to protect the operator against electrical shock. Removing the grounding device permits testing all bearings at the same time, even with the machine in service. Voltage of 120 with a 40-50 watt lamp in series across the insulation gives a satisfactory test. If the lamp glows, insulation is defective.

Upon discovery, the fault must be located as before. When sandwich insulation, consisting of a steel shim between two insulating sheets, is used, tests may show this steel sheet ungrounded either to the base or pedestal. The insulation of that particular pedestal is then generally considered good. It may not be true, however, because the insulating washer under holding-down bolt head *X*, in *C*, Fig. 4, may be defective or missing, and the steel center shim still test free because bolt does not contact it.

Furthermore, the steel center of the sandwich must be quite thick to prevent bridging by dirt particles. When thick it allows short-circuit forces on the pedestal to cause bending stresses in the hold-down bolts. Under the same circumstances a thin shim gives nearly a pure shear stress in bolts and dowels. The writer prefers a thin insulating shim rather than the sandwich type.

On the other hand, the equivalent of a sandwich shim serves to advantage in pipe lines leading to an insulated bearing. Two insulating couplings, Fig. 1, separated by a pipe nipple or elbow merely make it necessary to isolate the pipe insert electrically both from the bearing and ground.

Water piping subjected to rust, scale or semi-conducting water is more difficult to insulate than oil piping or electrical conduits. Some available plastic tubings are suitable for insulating water lines or electrical conduits, Fig. 1, if the temperature is within their safe range. For water use a generous length. Rubber hose minus metal reinforcing also serves for water. A great variety of insulating couplings serve for oil lines, but choose one that will not leak at the pressures employed for oil lift starting of low-starting-torque units.

Thermometer and relay bulbs in contact with an insulated bearing must have an insulating sleeve unless the instrument or relay itself mounts on the insulated bearing pedestal.

Sometimes it is desirable to run a supporting brace from a bearing pedestal to an air shield to prevent the latter from vibrating. Such a brace should be of insulating material or else insulated at one end, as in *D*, Fig. 4.

Insulation Failure

Coupling guards and handrails, connecting bearings and base, must be insulated when connected to an insulated pedestal. A hard-wood insert turned to match the outside diameter of the pipe makes good handrail insulation, *B*, Fig. 4.

The chief causes of bearing insulation failure are: (1) dirt, metal chips from drilling or reaming operations, especially after assembly; (2) carelessly placed tools or other metallic objects; (3) cracked insulating washers on hold-down bolts, or failure of both insulating sleeves to extend down into the base counterbore, *A*, Fig. 4 (Sometimes the bolts are machined undersize and insulation molded on them instead of using sleeves.), (5) metallic paint covering insulating-shim edges or some device connected to the bearing without proper insulation may also cause a ground. Watch repair jobs carefully.

PRACTICAL AIDS TO OPERATION

Overhead Lazyman for Electric Drill

DID YOU EVER TRY drilling overhead with an electric drill? If you have, then you know it is not an easy job. This led Evert Dustman, night-shift snapper in armature division, Erie Basin electrical shop, Todd Shipyards Corp, Brooklyn, N. Y. to develop the *lazyman* in the photo.

A piece of steel plate bent at right angles and welded to one end of a length of pipe supports the drill. This pipe goes into a second length with a bracket welded on its side near its bottom end. A lever pivoted to this bracket has a pin on one end that extends through a slot in the side of the outside pipe to below the end of the pipe that carries the drill. Then, as indicated in photo, by pressing down on the free end of the lever with one foot, operator raises or lowers the drill at will while both hands are free to steady it.

Before developing this lazyman, when holes were to be drilled overhead, ladders or complicated scaffolding was set up at considerable loss in production time. Now the drill is easily set up and the job done quickly.

Operates Feed Pump With Compressed Air

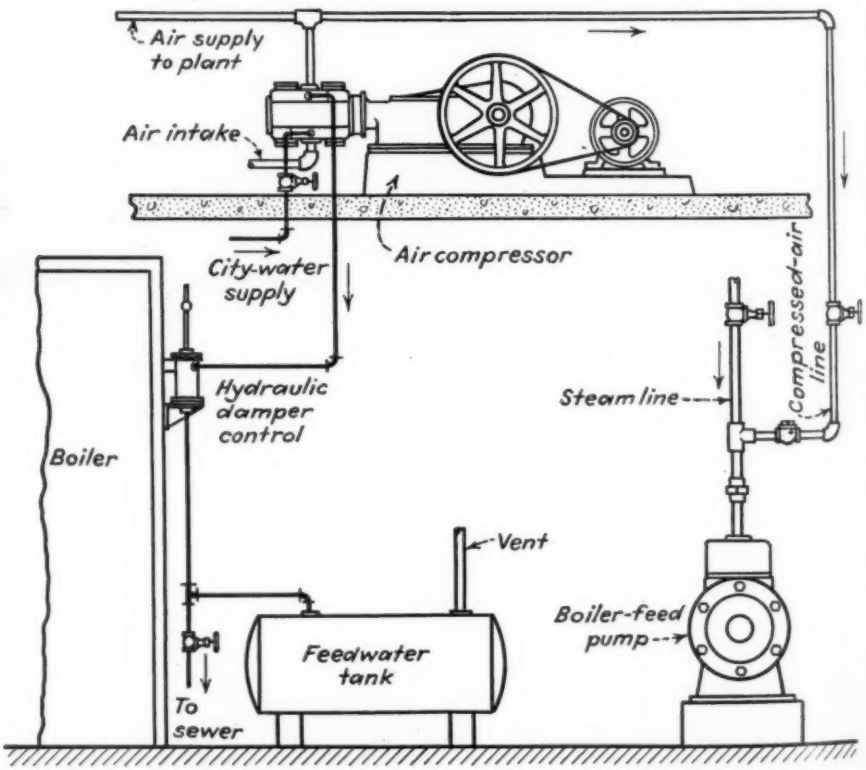
In our plant we had but one boiler. When we shut it down over a weekend for cleaning we had to fill it with untreated city water before starting it up. This water was of poor boiler quality, so we started looking around for a method of filling the boiler with treated water. We decided that the direct-acting steam boiler-feed pump could be operated by compressed air and connected it to the compressed-air system as in the diagram. This worked satisfactorily and saved the trouble of treating a lot of raw water in the boiler.

As originally hooked up in this plant, cooling water from the air compressors and water from the hydraulic operator on the damper was piped to the sewer. To save the water from both of these sources we connected them in series and put their discharge into the feedwater tank, as shown. At first we were afraid that the damper operator would not take enough water to cool the air compressor. After watching the compressor for a few days we found that cooling-water temperatures were about normal and then gave it only the usual attention.

Fairview, N. J. M N GOZDENOVICH

Canvas Screens Protect Welding Work

WE DO A LOT of repair welding around our plant and in our machine shop. The welders are always well protected by helmets, gloves, etc. However, other workers may be endangered, and to pro-



tect them, we constructed light screens that the welders set up around the work.

One problem was to make them light enough so that the welders can carry them easily from one job to another. We therefore use 20-oz. duck on 1x2-in. soft-pine frames. These frames are 2 ft wide by 6 ft high. Four are laid 2 in. apart on the floor and duck 6 ft wide securely tacked to them. The 2-in. space permits the screens to be folded into a section 2 ft wide and 6 ft long, which is easily carried and set up on the job. The screen needs no bracing to hold it upright because end sections can be turned out of line with center ones to give vertical stability. Being only 2 ft wide, screen sections can be set up in close places. When one screen does not give adequate protection a second or a third may be added.

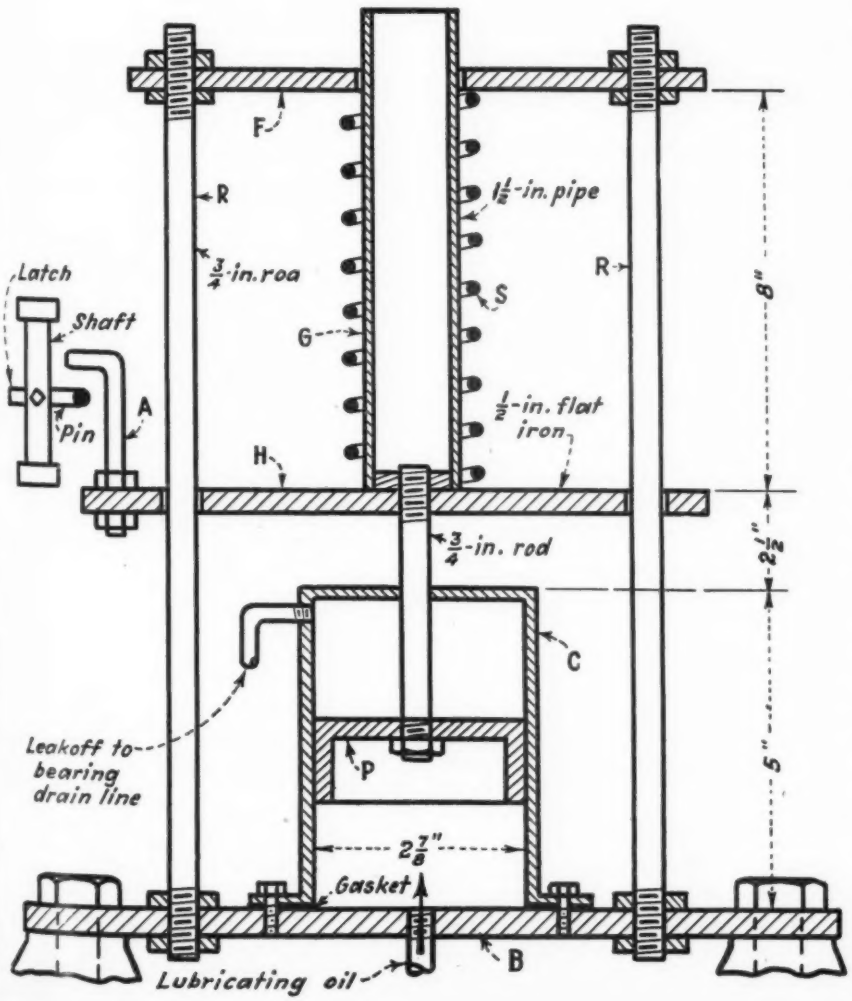
Detroit, Mich. L R Carry

Oil-Pressure Device Shuts Down Turbine

We needed a device to shut down a steam turbine in case the lubricating oil to its bearings failed, so we made the one in the figure from our scrap pile. Cylinder *C* and piston *P* were machined from an old cast-iron piston. Piston *P* connects to crosshead *H* and is guided on two rods *R*, fixed in a base *B*. Guide sleeve *G*, made from a piece of 1½-in. pipe, has a disk welded into its lower end that threads on the end of the piston rod.

Sleeve *G* passes through a fixed crosshead *F*. Spring *S*, between crossheads *F* and *H*, loads piston *P* against lubricating-oil pressure under it. We placed an arm *A* on the end of the moving crosshead *H*. This arm clears a pin through the latch shaft of the emergency overspeed trip gear as long as oil pressure is above a safe minimum. If oil pressure fails, spring *S* pushes piston *P* down to where arm *A* hits the pin in the latch shaft and trips the emergency valve to shut down the turbine. First one of these trips worked so well that we built and installed two more on other turbines. They certainly eliminate worry about what might happen to the turbines if lubricating-oil pressure fails.

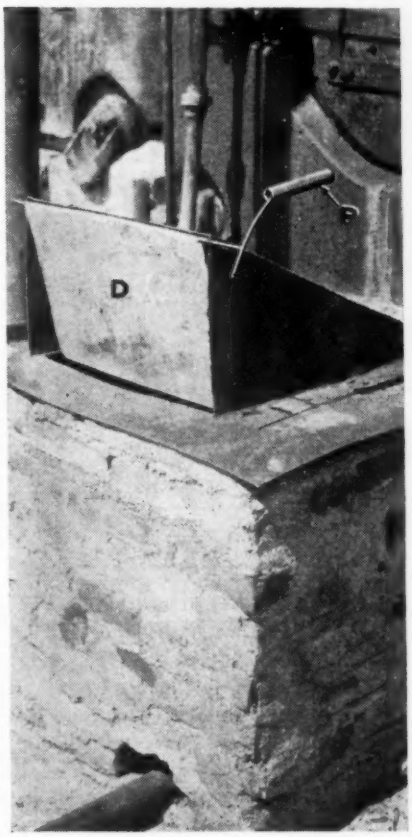
Great Neck, N. Y. S M Elonka



Balanced Damper Improves Gas Firing

On gas-fired boilers where the operator had difficulty controlling combustion air to the furnace, he devised the automatic damper of light sheet iron in the photo. He installed it above a brick chamber built in front of the boiler, through which combustion air passed to the burner and into the furnace.

In the intake to this chamber he supported a sheet iron damper, *D*, at its top



by a piece of welding rod on knife edges. This damper is counterweighted closed by a pipe nipple, *P*, on the end of another piece of welding rod welded to one end of the rod supporting the damper.

As more gas is admitted to the furnace and the stack damper opens to increase the combustion rate and furnace pressure decreases, balanced damper *D* swings inward to admit air to the furnace in proportion to fuel increase. A decrease in steaming rate causes the reverse of these operations to take place. Because considerable air is drawn into the furnace through the burner and other openings in the furnace front the automatic damper does not open more than a few inches for normal load on the boiler.

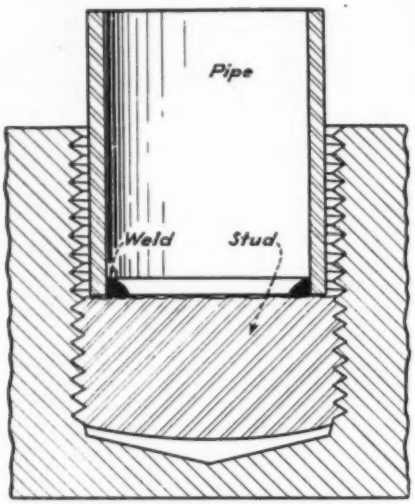
Evidence of how the damper affects

combustion efficiency can be seen by watching the furnace flame. With the damper in operation the gas burns with a hot blue flame, but with the damper inoperative it is an irregular yellow one.

Pomona, Calif. G M WILSON

Four Methods for Removing Broken Studs

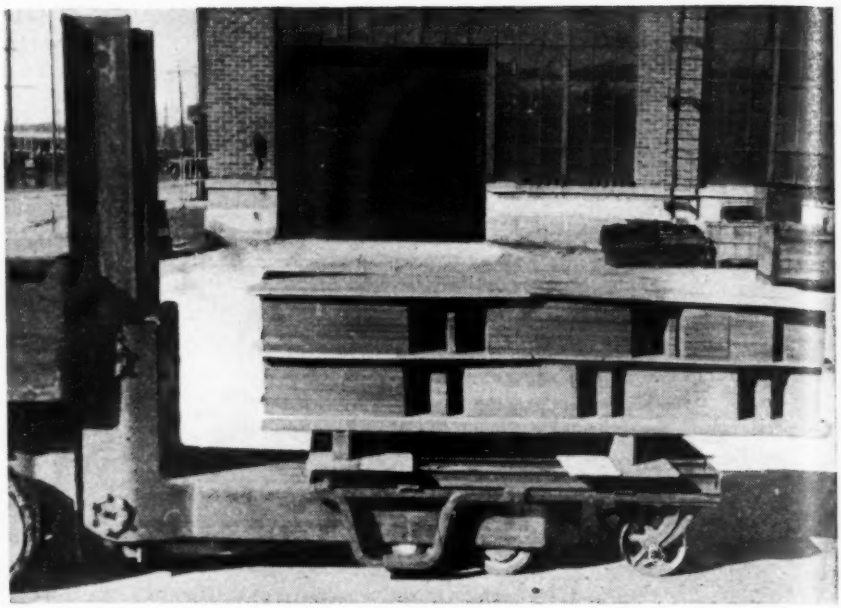
WHEN A STUD BREAKS OFF, failure generally occurs at or above the surface of the metal holding the stud. This permits removing the stud by (1) welding on a steel shank when the break is



flush or above the surface of the holding metal, (2) when the stud extends far enough above the holding metal, fitting on two thin jam nuts so that a wrench can be applied, (3) filing a flat surface on two sides of the stud for applying a wrench.

When the break occurs so far below the surface of the holding metal that none of these methods apply, the job takes on more serious proportions. We have removed such studs by putting a short piece of pipe in the stud hole of nearly the same diameter as the hole. We weld the pipe to the stud, which is then generally quite easily removed with a stilson wrench. If the stud persists in holding, it may be necessary to file the pipe with welding metal or in some other way support it from being collapsed by the wrench.

Toronto, Ont. DAVID A BURMA



Casters Treble Lift-Truck Capacity

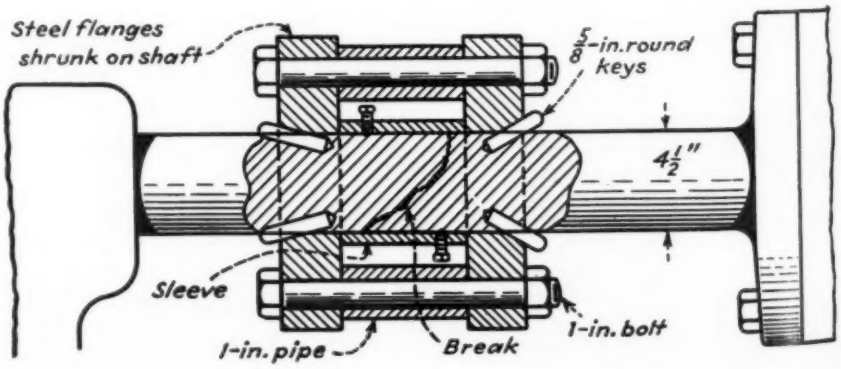
BY REPLACING TWO LEGS of a steel-skid platform, as in photo, F H Horton, transportation supervisor, General Electric's Pittsfield works, made it possible to handle loads as great as 10 tons by a 3-ton lift truck. Because the casters support more than half the load the truck lift is not overloaded. Casters are welded to the steel skids so that there is no danger of their working loose.

Emergency Repair on Broken Pump Shaft

ABOARD SHIP we often make repairs that ashore would be attempted only in a remote corner of nowhere. The diagram shows how we repaired a broken shaft of a condenser circulating-water pump. From scrap iron carried as cargo we machined two flanges about 2 in. thick, to go on the pump shaft each side of the break. Holes in the center of these flanges were bored about 0.004 in. smaller than the shaft. They were then bolted together and six holes drilled through them in line.

We heated one flange and shrunk it on the shaft. We then made a sleeve with an inside diameter a few thousandths of an inch smaller than the shaft. After heating this sleeve we positioned it on the broken end of the shaft against the flange and forced other parts of shaft with its heated flange in position. When the sleeve cooled, it firmly held the broken shaft ends together. It took a large part of the torque and permitted using comparatively small bolts in the flanges. To make sure the sleeve would hold, we bored and tapped it for six set screws that were tightened into place after the sleeve cooled on the shaft.

We machined six pieces of galvanized pipe to the same length as the sleeve to act as spacers between the flanges and tightened the bolts. The flanges were then keyed to the shaft by drilling four ⅝-in. holes and driving in oversized round keys as shown. This repair job lasted three months until we returned to San Francisco when a new shaft was installed. Apparently the repaired shaft



would have served indefinitely because it showed no signs of distress when it was removed.

To make the repair the impeller had to be removed from the pump. After this was done we replaced the shaft with a piece of pipe having the same diameter and packed the glands to make the casing water tight. A ballast pump was then used as a circulator to operate the ship at half speed until the pump shaft was repaired, which required 24 hr.

Great Neck, N. Y. S M ELONKA

Schedule Numbered On Soot Blowers

OTHER BOILER OPERATORS may have their own pet idea about boiler soot blowing, but here is the way we do it. To help the boiler operators follow a schedule we have numbered the blowers consecutively, from 1 to the total number in the boiler. Numbers run from front to back of boiler. Blowing starts at No. 1 in front and follows through to rear in consecutive order of the blower, following up or down with the baffles and direction of gas flow.

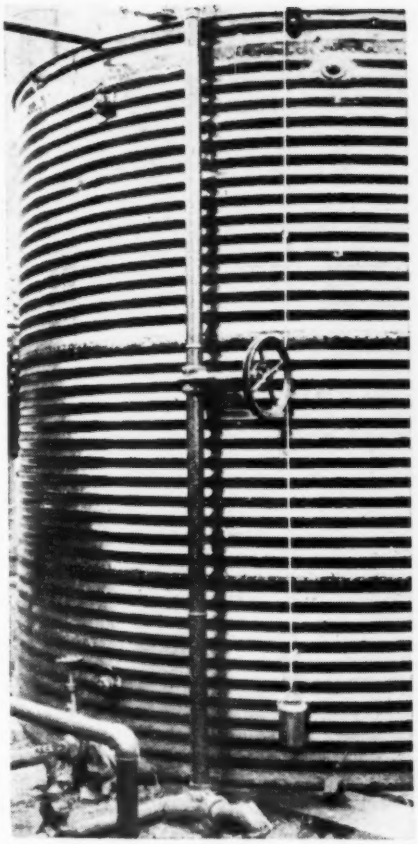
This gives a much cleaner boiler than when we started soot blowing at the back of the boiler and worked through to its front. Economizers are cleaned in the same order. During the cleaning period the stack damper is kept wide open to insure a strong draft through the boiler to carry out the soot and prevent it lodging in the gas passages.

Ottawa, Ont. JOSEPH BONGIORNO

Float-Actuated Valve Maintains Water Level

ONE ENGINEER devised the labor-saving method in the photo for maintaining constant level in the soft-water tank supplying feedwater to his boilers. Instead of piping the water into the bottom of the tank he ran the 2-in. line up outside the tank and installed a gate valve near the center of the upright section of pipe and clamped an old throttle-valve wheel with a groove cut in the periphery to the hand wheel of the gate valve.

He then ran a light flexible wire from a large float on the water surface in the tank over a pulley at upper edge of tank, wrapped it twice around the throttle wheel rim, and then connected it to a weight below the valve. He suspended the weight high enough so that it would not strike the ground when the tank was full and the gate valve closed. Now as the tank empties or fills the valve opens and closes to maintain a constant level in the tank regardless of withdrawal rate for the boilers. To permit valve to operate as easily as possible its packing is held with a minimum of pressure that prevents leakage.



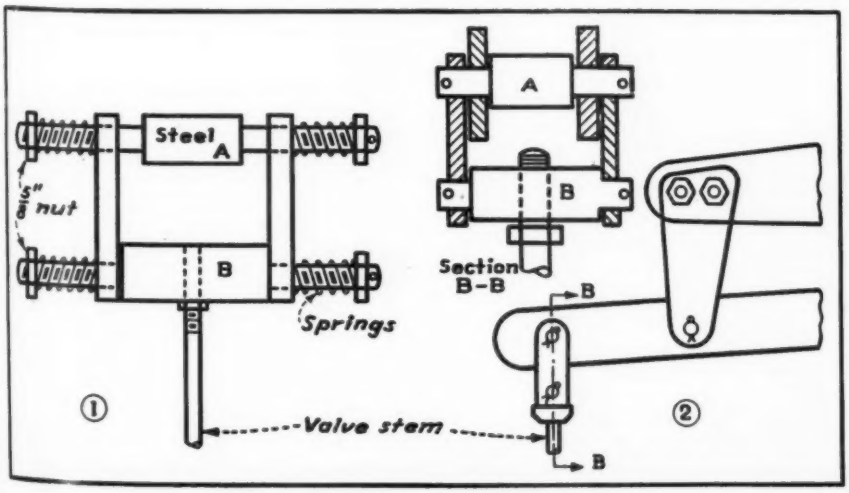
Pomona, Calif. G M WILSON

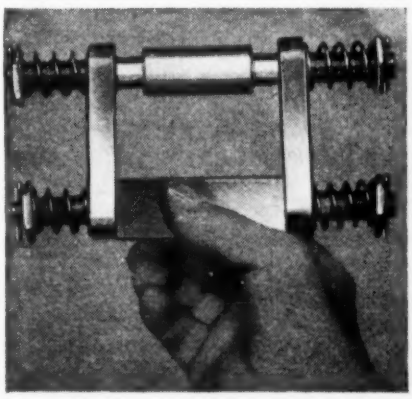
Valve-Connection Change Improves Turbine Regulation

ON ONE of our steam turbines the valve-lifting connection was designed as in *B-B*, Fig. 2. Steam passing through the 4-in. valve put a twisting force on the stem and its connections to the operating levers. In a few months this action caused the side bars and pins to wear and the valve to stick and interfere with correct governor action. As a result the turbine would hunt 0.1 of a cycle.

To correct the trouble we rebuilt the lifting connections, as in Fig. 1, and extended the ends of pins *A* and *B* so that springs could be put on them to hold the lifting bars in place. The photo shows the new design of this connection which has eliminated our previous trouble. Since adding the springs the valve stem finds its proper alignment and the valve moves freely with good turbine regulation.

Columbus, O. FRED E SCHUBERT
Chief Engineer,
Municipal Power Plant





READERS' PROBLEMS

Questions From Our Readers

SUITABLE ANSWERS from readers will be paid for if space is available for publication. Answers that are accompanied by rough drawings or photographs will command additional pay.

Question 1

How About an Air-Conditioning System?

OUR CONTROL ROOM gets extremely hot in summer from heat radiated by numerous resistors and indicating lamps.

Since there is sufficient water to operate the vacuum jets on a refrigerating unit, will water serve for this purpose as well as steam? Water pressure at jet would be low (approximately 5 psi) but discharge would have a free drop of 45 ft through the tail pipe. Would this arrangement provide sufficient vacuum in a spray evaporator tank using water as the refrigerant?

The room is 60 ft wide, 100 ft long and 12 ft high. Inlet and exhaust fans now installed supply five air changes per hour; with incoming air at 80 F room temperature averages 110 F—*HF*.

Question 2

Can We Prevent Receiver Drain Freezing?

WE USE COMPRESSED AIR almost entirely to operate our heating system thermostatic controls—all located inside warm buildings. The main air receiver is located outside and we have considerable trouble with the drain line freezing in cold weather. How can we prevent this trouble?

Can we introduce alcohol or other anti-freeze into the receiver for this purpose? If so, will it separate out in filters if its presence is undesirable in certain air uses? Capacity of our system is 200 cfm.—*DLW*

Answers to Dec. Question 1

How Do You Connect Blowdown Tank?

REFERRING *to the two blowdown tanks,* A *and* B, *I would like to know if pipes are installed properly; if so, please give the reason. The pipes in the vertical tank do not appear correct to me. If the discharge pipe is as high as the inlet pipe, there isn't much space left for partial storage of boiler blowdown. If the pipes are at the height shown in the sketch (from page 203 of* Steam Boilers, Power-Plant Series—*Croft) the discharge will go out the vent pipe when the blowdown valves are open as the discharge pipe wouldn't take care of the blowdown, plus the water already in the vertical tank.*

The horizontal tank has a drainpipe, but wouldn't it be better to have a discharge pipe on the end of this tank about one third the distance from the bottom to allow sludge and part of the blowdown to remain in the tank to act as a cushion for the next boiler blowdown? I agree that a drain valve is needed but I would like to know the proper size, as the one in sketch looks too small. There is a possibility of the line clogging, and defeating its purpose. What is the best way to connect a blowdown tank and how should internal piping be arranged?—FCT

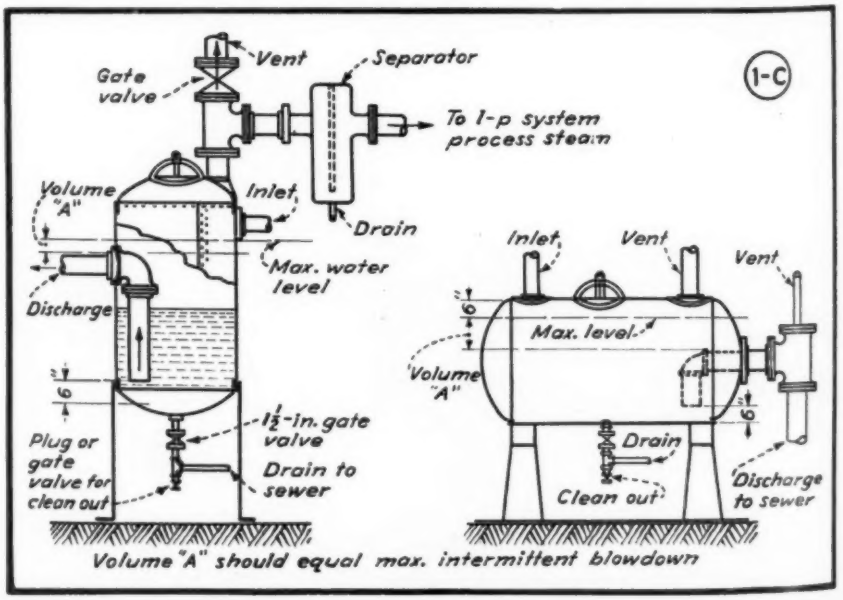
Don't Submerge Inlet

PIPING CONNECTIONS for a blowdown tank should be so arranged that the water is delivered to the sewer at the lowest pressure and temperature.

Discharge pipe should have a free area at least twice that of the inlet pipe and be carried within 6 in. of the tank bottom. In practice, it is usually unimportant whether a siphon breaker connects to the discharge pipe. If blowdown water is dirty, sludge may be flushed out more easily if the tank empties to internal pipe openings.

Vent should be large enough to relieve flash steam without building pressure in the tank. This depends on blowdown temperature and quantity, but it should be as large as the discharge pipe, and in most cases larger. As a guide, a 6-in. pipe carries 2700 lb steam per hour at atmospheric pressure and 100-fps velocity. Under the same condition a 12-in. pipe carries 10,600 lb per hour. Blowdown water at 400 F produces about 1 lb flash steam for every 5 lb water.

Use of flash steam, by connecting the tank vent through a separator to a low-pressure system, should be investigated if blowdown quantity is large, and particularly if blowdown is continuous. With continuous blowdown systems,



heat recovery from water after removing flash steam is usually justified. A relief valve is required unless the low-pressure system has automatic control.

Fit drain valve as close to tank as possible. Make connection below the valve to allow pushing a rod through to dislodge sludge when the valve is open. This is especially necessary with blowdown carrying large amounts of sludge as the drain usually plugs in less than 24 hours. Drain valve and piping should not be less than 1½ in.

Blowdown tank inlet must never be submerged. With intermittent blowdown the tank contents are cold and the first water from blowdown flashes in the piping. This steam is quickly condensed to form a partial vacuum and reverse water flow if the inlet pipe is sealed in the tank. Disastrous results to blowdown piping may follow.

FCT's vertical tank sketch has been widely used in publications since 1901. Good practice would make it desirable to add a drain, increase the vent size and carry the discharge pipe down lower inside. Vent pipe in tank *B* is too small for normal service. Installed as shown, water would be discharged from the vent pipe and probably piping would be damaged with tank full of water. My sketch, 1-C, shows suggested alterations.

Saint John, N. B. C G CLARK

Install Cold-Water Line

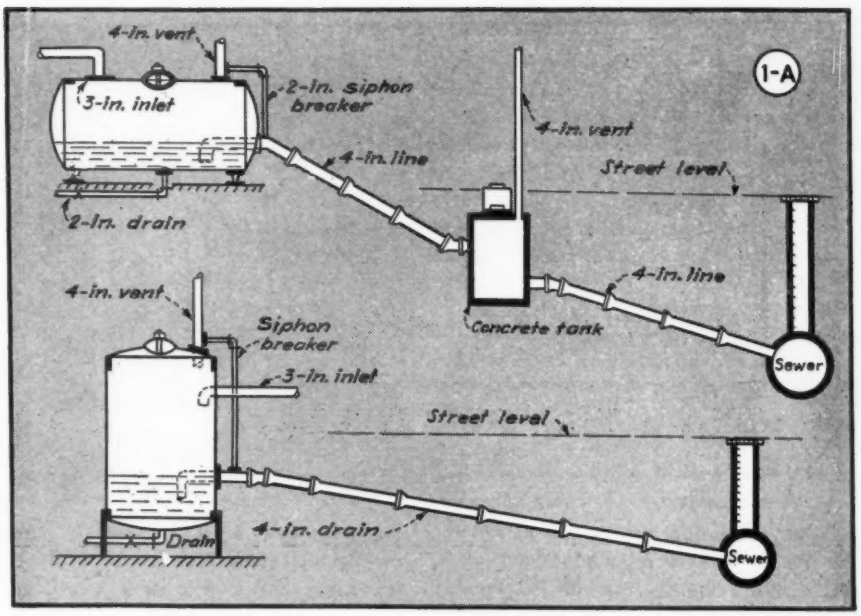
I BELIEVE the discharge pipe in the vertical tank is too high because after blowdown there will always be water up to the pipe center line. If the water level remains this high, there will not be much cushioning effect on following blowdowns. I am familiar with a similar installation in which water issued from the vent pipe with a geyser effect.

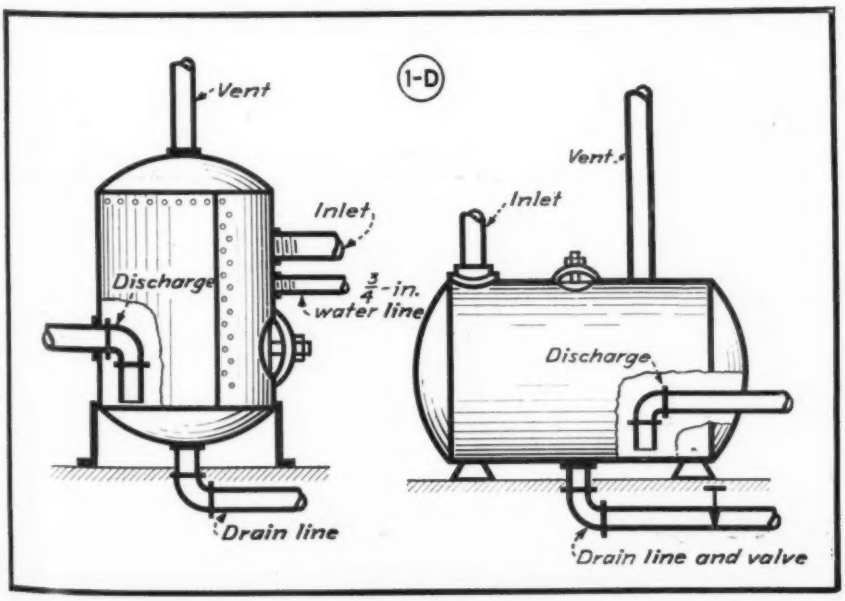
Discharge pipe in the horizontal tank is too high and the same condition exists as in the vertical tank; the water level will be at top of tank. My sketch, 1-D, shows how I think these tanks could be improved. This vertical-tank hookup was in the boiler room of a plant where I worked. As soon as the discharge reached a moderate temperature, it was drained from the blowdown tank. The cold water line to the tank was used to fill it, which acted as a cushion. After a year's operation hardly a handful of sediment or scale was found inside.

I operated the horizontal tank in a laundry. Its discharge pipe was about a foot from the tank bottom, the tank being about 30 in. in diameter. The only drawback was its location in an alleyway just back of the wall behind the boiler room. In cold weather, there was a rumbling sound caused by difference in temperature between the hot-water blowdown and the cold water from the previous blowdown.

One requirement for successful operation of this equipment is proper care. Installing a water line serves for washing the tank periodically and supplying water for cooling the blowdown. Important points are (1) prevention of undue strain and rumbling, and (2) clean tank and piping at all times.

Philadelphia, Pa. W T MULLEN

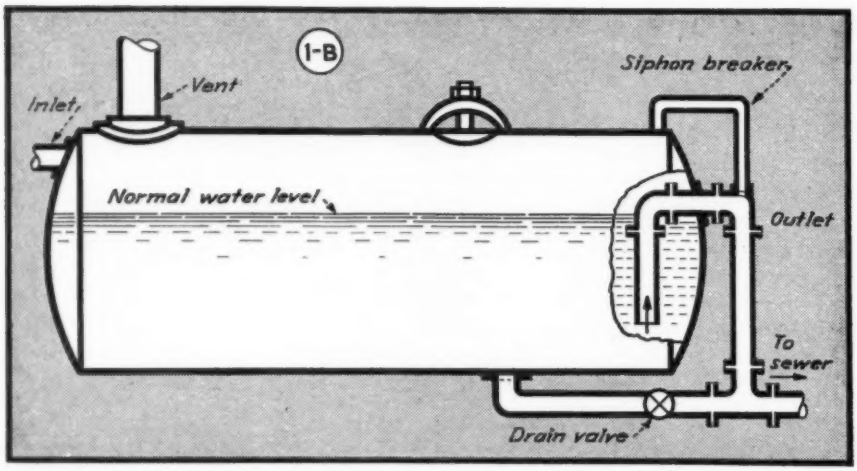




Why Not a Separate Concrete Tank?

FCT's QUESTION is not so difficult because with one exception, sketch shows a good blowdown-tank piping system. Leaking boiler-blowoff valves or drip lines connected to the tank would gradually fill it. Then when the boiler was blown down, tank volume would be zero and pressure would build up quickly. But no water should go through the vent because internal pressure would force water out to sewer line and down to level of the inverted elbow. In Croft's sketch the vertical tank could siphon itself almost empty because it has no siphon breaker; this cannot happen on the horizontal tank.

Drain valves on these tanks are small and are used only to empty the tank for cleaning. The idea, of course, in the Croft design is to have as much water in the tank as possible to prevent



steam blowing into the sewer at the expense of reduced tank volume.

In my proposed sketch, 1-A, sewer outlet elbow is lowered and siphon breaker prevents the tank draining itself. When blowing down a boiler for, say, two minutes at 200-psi pressure, remember that discharge water is under high pressure and temperature and a certain amount flashes into steam as it passes blowoff valve. But upon reaching the tank it expands rapidly in the greater volume and some flashes into steam, building up pressure and forcing the cold water out. The submerged outlet water seal keeps steam from entering the sewer while vents relieve steam to atmosphere. Any water not flashed to steam keeps tank filled to outlet opening.

Piping connections to sewer must be made with the consent of local municipal authorities depending on whether the plant is in a factory or residential district. Tank discharge line should be separated from building sewers to prevent breaking water seals in trap lines. Any one who has watched a blowoff-tank vent during blowdown appreciates the pressure developed in sewer lines; if district sewers are small, install a separate concrete tank between sewer and blowoff tank.

Remember to pipe tank so that it will not remain full of water as you must have sufficient free volume to break down the blowoff pressure before it discharges to sewer.

Ottawa, Ont. JOSEPH BONGIORNO

Prefers Horizontal Tank

TANKS IN FCT'S QUESTION will work satisfactorily under normal conditions because inlets are smaller than outlets. This allows water to blow out the tank as fast as it comes in. The purpose of storage water is to prevent hot water and flash steam being blown directly to the sewer or outside where it will endanger workmen. Water in the tank cools and as the discharge is near the bottom, cool water is blown out first; hot water and steam come in on top of the water surface. The tank should be large enough so that discharge water will still be cool when blowdown stops.

The drain line serves only to empty the tank for cleaning or repair. Size of drain depends on time allowed to empty the tank. It should drain the tank quickly, permitting it to cool, be cleaned and put back in service for the next blowdown period. Remember, a large drain does not clog easily.

If there are only one or two boilers, operating only during the day, the entire outfit need not be so large but if there are many boilers, operating 24 hours a day, all using the same tank, the installation must accommodate the many blowdowns.

Sketch 1-B shows a blowdown tank installed several years ago that worked satisfactorily on a 100-hp boiler. I located it outside the boiler room, buried part way in the ground. Insulation prevented freezing. I prefer the horizontal blowdown tank because there is more room on the surface of the water for flash steam, which helps to prevent high pressure and consequent blowing of steam and hot water out of the vent.

Baltimore, Md. C W PARKS

Drill Hole in Elbow

FROM FCT'S QUESTION I gather that he believes the drain valve remains open and the tank empties after each blowdown. This is not true as both tanks are piped to leave tank *A* nearly full and tank *B* full.

Piping is correct because it provides sufficient comparatively cool water to prevent hot water and steam entering the sewer and causing possible damage.

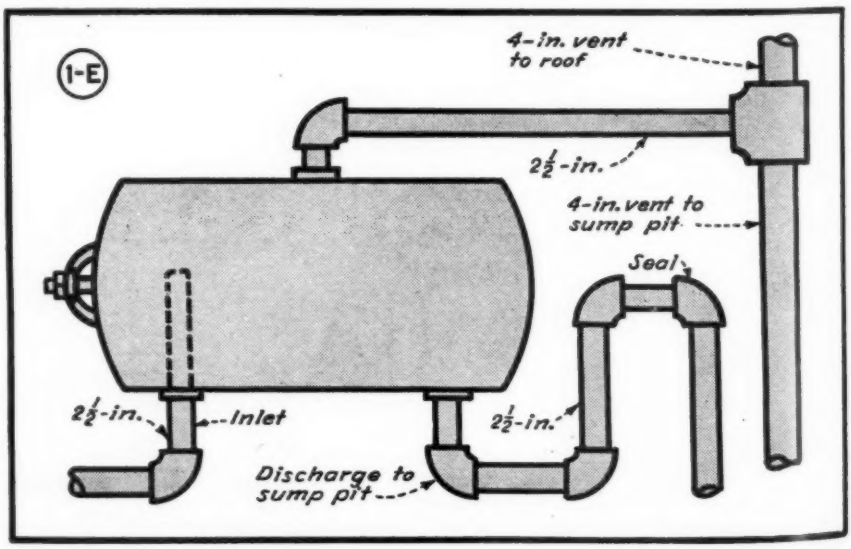
Vent pipes should equal size of the largest individual boiler blowoff valve. Discharge piping from tank should be twice the diameter of inlet piping to prevent pressure build-up in the tank.

Tank *A* should have a $\frac{3}{8}$-in. diameter hole drilled in top internal discharge pipe elbow to prevent siphoning.

Hamilton, Ont. J CAULDEN

Blowdown Tank Leads to Sump

Sketch 1-E shows a blowdown tank that we installed several years ago. Inlet pipe and discharge are each $2\frac{1}{2}$ in. Vent is also $2\frac{1}{2}$ in., connecting to a 4-in. vertical riser leading to the roof and also to the sump pit. Two boilers, in service at all times, are blown down periodically one hour apart.



When the first boiler is blown down, the water just about half fills the tank. It remains in the tank about one hour and has a chance to cool off before the second boiler is blown down. The cooler water from the first blowdown helps absorb heat from the second.

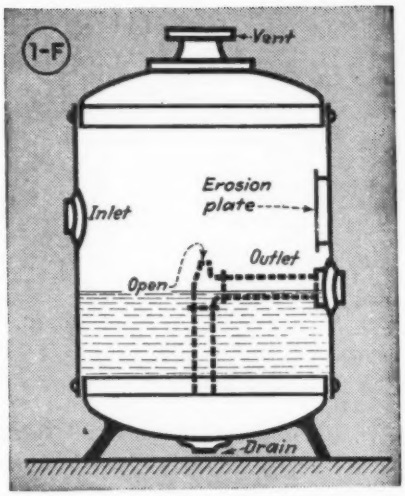
Water from both boilers just about fills the tank, and flows out the pipe seal to the sump pit; the water then completely siphons from the blowdown tank and mixes with cold water in the sump.

The boiler room is below sewer level so all sump water is pumped to the sewer.

Bronx, N. Y. ANTHONY GREER

Inlet Becomes Submerged

DISCHARGE from FCT's vertical tank would not occur until the water reached a level equal to that of the discharge outlet. This level would obstruct free flow from the blowdown inlet. Then



after blowdown had stopped, water would continue to issue from discharge line until tank was nearly empty because no provision is made to break the siphon effect.

Discharge would not take place from the horizontal tank until a slight pressure was built up inside because the outlet proper is higher than the tank. Since the siphon breaker is higher than the tank it would always remain full of water. Often this means that boiler blowoff line would remain filled with sludge-carrying water, precipitation of this sludge eventually obstructing free discharge.

Main purpose of a blowdown tank is to prevent flash-steam discharge to the sewer. This means the tank must contain a quantity of cold water when blowdown begins.

Sketch 1-F shows our arrangement of inlet and discharge lines which is supposed to keep the inlet pipe unobstructed. But is this true? Suppose we consider the theory that no pressure should build up in the tank. If true, how can water flow out the discharge by gravity as fast as it enters under

(*Continued on page* 172)

Answers to Dec. Question 2

Does Ventilation Affect Drying Room?

WE HAVE A DRYING ROOM *for removing moisture from plaster wall board, the boards moving through on constant-speed rollers. A certain amount of moisture must be left in the material to prevent calcining. Air pressure inside the drier varies slightly above and below atmospheric.*

Heat is supplied through pipe coils using steam at 150 psi. Two fans recirculate the kiln air and an exhaust fan provides ventilation. Kiln temperature is 320 F at the entrance and 225 F where the boards leave, and is regulated by pressure controllers in steam lines to the various coil sections.

Since the temperature is always well above 212 F, I don't see how condensation could take place. So why is it necessary to exhaust any of the heated air and moisture? Doesn't the superheated moisture carry the heat as well as the heated air?—BG

Air Flow Depends On Drying Rate

SINCE THE TEMPERATURE in BG's drying room is above 212 F at atmospheric pressure, air saturation will never be reached, if the air is constantly recirculated. Eventually, he would be recirculating superheated steam. Furthermore, if there were no means of constantly introducing some fresh air and exhausting air that had been recirculated, rate of drying would be reduced, and the plaster boards could not move through the room at a constant rate. Amount of fresh air to introduce would depend upon the desired drying rate.

An additional exhaust fan is not necessary. Run of ducts on either side of fans can be balanced and openings provided to discharge desired amount of air to the outside on the discharge side of the recirculating fans, and introduce an equal amount on the intake side of the fans. A set of control dampers can be designed to regulate the amounts closely. As an alternative, the fresh air can be introduced on the intake side of the recirculating fans and an equal part of air exhausted through the opening for passage of the plaster boards.

Yonkers, N. Y. R M HENN

Continuous Exhaust

IF BG's KILN is not continuously exhausted, its vapor pressure will rise, thus reducing evaporation from the product since the evaporation rate is a function of the difference between kiln vapor pressure and that of the product.

Yorktown, Va. I R BERKNESS

Regulate Surface Temperature

THERMAL REMOVAL of moisture from BG's material may be carried on either by drying or evaporation. Drying a solid usually infers removal of relatively small amounts of water in the presence of inert gases or air—removal of water at temperatures below normal boiling point, whereas evaporation means water removal at a saturated boiling temperature.

Surface water may usually be evaporated rapidly without affecting properties of the material. After surface moisture is removed, the problem becomes one of bringing moisture from the interior of the material to the surface and drying rate should usually be reduced to prevent surface hardening and/or excessive surface temperature.

During early drying stages, stock temperature tends to become the wet-bulb temperature of the drying air. As moisture content of the material diminishes, a point is reached where the ability to deliver moisture to the surface becomes less than that of the air to evaporate such water. This causes the plane of vaporization to move from the surface to the interior and, in turn, surface temperatures rise above the wet-bulb temperature of the drying air. Once the plane of vaporization starts moving into the interior, drying rate begins to and will continue to diminish until all free moisture is removed.

(*Continued on page* 176)

REFRIGERATION NOTEBOOK — 11

Snug Ring Fit Prevents Oil Pumping and Blowby

By TERRY MITCHELL, M E, *Frick Company*

As long as refrigerating compressors were vertical open units, piston rings gave the engineer no special worry. But inclosed compressors have trunk pistons, with two separate sets of rings: Suction gas enters through openings between the two sets, and passes into each cylinder through a valve or valves in the piston top. The trunk piston, Fig. 2, serves both to take up connecting-rod thrust (as a crosshead would) and to separate the working part of the cylinder from the crankcase: a dome-shaped web, cast in the piston just above the wrist pin, seals off the suction gas. The rings above the suction inlet are compression rings, those below it oil rings.

On each stroke of the piston, there is a decided tendency to pump oil up past the lower set of rings. All kinds of remedies have been tried to stop this oil-pumping. The commonest method used on present-day machines fits special oil-scraper rings in the two bottom grooves; holes drilled behind these rings, and sometimes between them, drain the collected oil back into the crankcase. It is essential that these holes be large enough and numerous enough to prevent oil accumulation around the rings. When properly applied, this plan allows so little oil to leave the crankcase that on larger machines it is necessary to lubricate the upper cylinder walls with a force-feed oiler.

Compression rings at the top of the piston usually follow conventional design. They should fit into the grooves so neatly that no appreciable up-and-down play can be felt. A clearance of 0.002 to 0.0035 is good practice. A gap of 0.00075 to 0.001 in. per in. of circumference is allowed at the ends of both compression and oil rings, when fitting them in the cylinder. All rings should have a slightly greater diameter in the direction of the joint than in the opposite direction when compressed until the ends nearly meet; this assures a positive outward pressure at the ends, and protects against end fluttering.

In recent years the babbitt-insert ring has been employed by some builders; these, together with honed cylinder walls, give a better sliding action than iron against iron, and help a new machine to *break in* more quickly. For higher piston speeds, bronze-inserted rings prove most effective; in the absence of oxygen, the oil apparently protects the bronze from the ammonia.

To avoid breakage, always use the ring guide provided with the machine when inserting or removing a piston. Do not twist the ring when opening to slip it over the piston as the ring may become so distorted that it will never again maintain a seal along the sides. And since the sides do not have any sliding action to help wear a tight seat, any lateral warping ruins the effectiveness of the ring. Fig. 1 shows how the oil builds up in front of and is forced behind the rings on the piston's down stroke: lack of either drain holes or a good seal at the top of the ring will certainly result in oil-pumping.

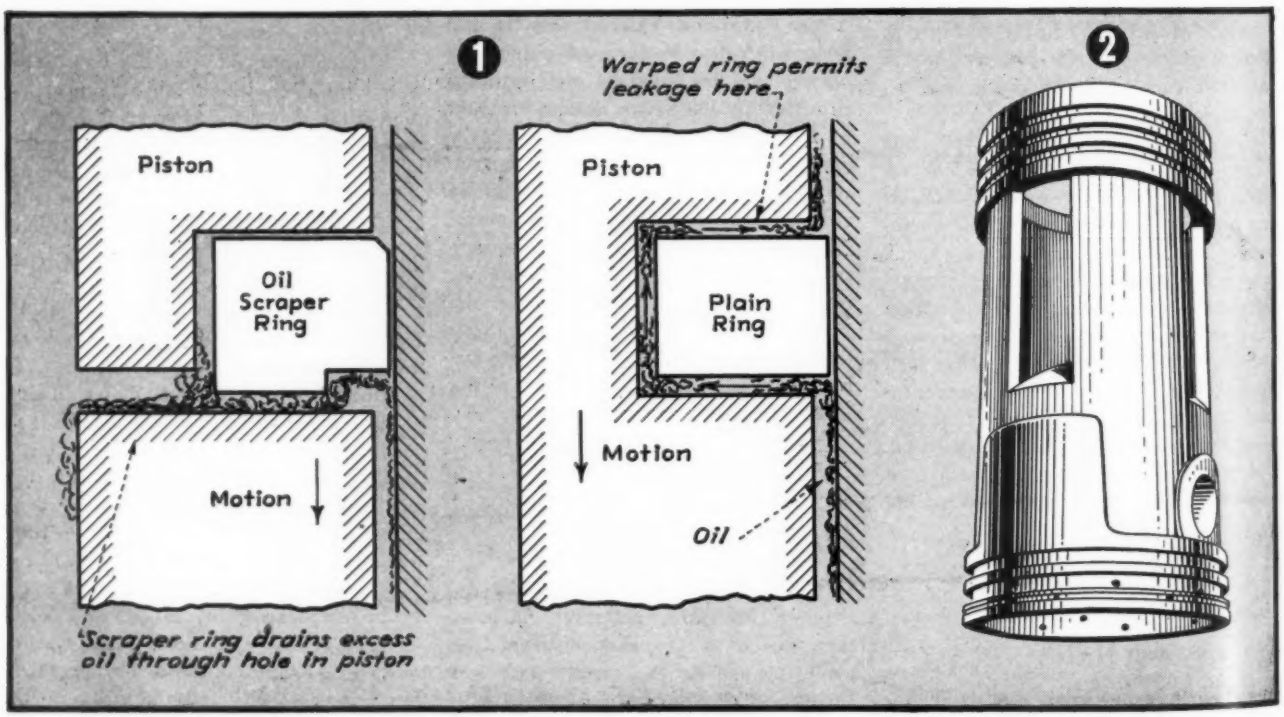


Fig. 1—Poor seal between ring and groove or lack of drain holes causes oil carryover into the refrigerant passages where it interferes with heat transfer. Fig. 2—The trunk piston carries both compression and oil-scraper rings

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Q&A QUESTIONS & ANSWERS FOR POWER ENGINEERS

By ALEX HIGGINS

11—*Boiler Foundations and Erections*

Eleventh in a series that is running in every number of* POWER. *From long experience as a professional and practical engineer, Alex Higgins asks and answers some direct questions regarding power equipment.

Q 1—How do you lay out the foundation for a battery of boilers?

A—Outline the foundation wall on the ground with reference to some base line, such as the boiler-room wall. Use a measuring tape, preferably steel, and a large square. Corner markers, which are set well back from the excavation edge so that digging the trench won't disturb them, may be wooden stakes. However, *batter boards*, Fig. 1A, are better, and their tops should be leveled. Then lines are run to guide the excavation work and provide checking points for height of foundation walls, Fig. 1B.

Depth and width of excavation depend on the soil. In solid ground, a shallow trench may be all that is necessary to reach *hardpan*. If really solid footing means going to a great depth, and the ground is fairly firm and well drained, it may be possible to insure a stable foundation by widening the trench and placing a concrete slab on the bottom. This footing slab, or *mat*, should be at least 18 in. thick and reinforced with steel or iron bars.

When the ground is soft to a considerable depth, and a more suitable location cannot possibly be selected, you may have to drive a large number of piles and then run a wide reinforced-concrete mat over their tops to give a still greater bearing area.

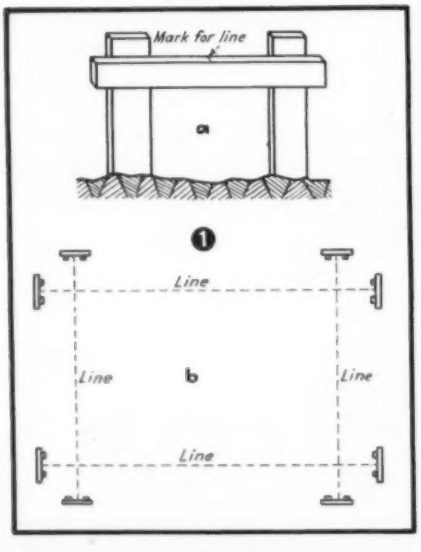

Fig. 1—A: batter board; B: method of marking off the foundation walls

Q 2—What are average bearing capacities, in tons per sq ft of rock, gravel, sand and clay?

A—No exact figures can be given as these materials vary greatly in composition, and their bearing capacity is strongly affected by presence or absence of moisture. Various competent authorities give these average values:

Nature of ground	*Safe bearing strength, tons per sq ft*
Hard rock	40
Soft rock	8
Hard dry clay	4
Wet clay	1
Cemented gravel (hardpan)	10
Gravel	6
Coarse dry sand	4
Wet sand	2

Q 3—How do you make and set forms for a concrete foundation?

A—Make them of common boards, at least ⅞ in. thick, with one or both sides smooth. These boards are nailed, smooth side inward, to two by four's, making the joints so tight that concrete can't leak through. Place forms in the trenches on the footing slab, so braced to each other and to the sides of the trench that they cannot move when the concrete is poured. The space is filled with concrete and the top is smoothed off to provide a level footing for the brick walls.

Bottom bolts for columns are embedded in the concrete if steelwork is to support the boilers, and the whole mass is allowed to set a few days before removing the forms and building the walls. Make sure concrete is set hard before removing the forms.

Carefully check alignment of the forms with the base line and dimensions on the plan before pouring.

Q 4—What are proportions of sand, gravel and cement for boiler or engine foundation?

A—Strength of a concrete mixture depends on nature and proportions of ingredients and mixing method. Proportions of cement, sand and gravel again depend upon size and type of machinery to be supported. Less cement is needed if the aggregate (crushed rock or gravel) is of uniform size.

Strongest concrete mixture commonly used runs about 1:1½:3, indicating proportions by volume of cement, sand and gravel in that order. The weakest mixture runs about 1:3:6. The first mixture would be suitable for foundations for heavy vibrating machinery, the second for light smooth-running machines. Boiler foundations carry heavy weights, but are not often subjected to excessive vibration, so a medium mixture, say, 1:2:4, should usually be satisfactory.

For maximum strength, use clean sand of good quality, the aggregate composed of gravel or crushed hard rock. Cinders, soft rock (like limestone) or dirty clayey sand produce a weak concrete and may ruin the foundation, causing great trouble and expense later.

Q 5—How do you mix concrete for a boiler or engine foundation?

A—If a mechanical mixer is available, the proper amounts of sand, gravel and cement for one batch are thoroughly mixed dry. Then only enough water is added to make the concrete sufficiently plastic to fill all spaces when it is poured and tamped into the forms. Too much water tends to float out cement and weaken concrete.

For hand-mixing, dump the measured amounts of sand, gravel and cement on a large watertight board platform and mix thoroughly while dry. Then add enough water to make the mixture into

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YARWAY IMPULSE STEAM TRAP

Q&A FOR POWER ENGINEERS

(*Continued from page* 116)

a stiff plastic for further mixing. Main essentials of good concrete are thorough dry and wet mixing, clean sand and gravel, and not adding too much water.

Q 6—What proportion does the dry material bear to the mixed concrete?

A—Separate dry ingredients of concrete always occupy more space than the wet mixture. Shrinkage averages 25%. Right amount of water in mixing is important.

Typical proportions of cement, sand, gravel or crushed rock, and water for a 1:2:3 mixture are:

6 sacks cement (approx 6 cu ft)
12 cu ft sand
18 cu ft gravel or crushed rock
38 gal water (6 1-3 gal per sack of cement)

Q 7—How do you pour concrete in boiler foundation walls?

A—It is common practice in a small job to load the concrete into wheelbarrows by hand shovel, or direct from the mixer if a machine is used, and arrange plank tracks so that the concrete can be wheeled and dumped directly into the forms. As the concrete is poured, it is tamped with an iron bar to make sure no holes or cavities are left unfilled. This is particularly necessary when the concrete is mixed fairly stiff.

Do not run concrete in freezing weather if it can possibly be avoided. If it must be run in cold weather, heat the sand and gravel, using warm water in mixing and covering the concrete with some heavy material to prevent freezing before it starts to set.

When the forms are filled to the required height, place the column foundation bolts in positions, if supporting steelwork is to be used. Then smooth the top of the concrete to provide a level base for the brickwork. Allow the concrete to set properly before the forms are removed and the walls built.

Q 8—How do you erect boilers after foundation walls are finished?

A—When the concrete in the walls has set hard, the forms are removed and the excavation filled in. The ashpit and combustion chamber floor can now be laid and allowed to set. Next step depends on the types of boilers being erected. Haul hrt boilers into position over the foundation, jack up and support on blocks about where they will finally stand. Small hrt boilers are usually supported by brackets resting on the side walls. Suspend large hrt boilers from steel beams supported on steel columns.

If the boilers are to be supported by brackets resting on the side walls, walls are built up to the finished height and the blocking removed. If steelwork is used, the supporting columns and cross beams are placed in position, and bolted to each other and to the foundation bolts. The suspending bolts can also be attached to the cross beams and the boiler hangers. But do not remove the blocking underneath the shell until the columns are braced firmly in every direction.

Carry brickwork as high as possible before removing the braces and blocking, and take great care when removing the blocking to prevent any rolling or swinging of the shell that would throw a sudden load or side thrust on columns and braces. When the bottom blocking has been removed, carry the walls up to full height and finally discard the column bracing.

Practically all multi-drum watertube boilers are supported by steelwork, erected before the drums are set in place and the setting built. Observe the same precautions in securely bracing columns and beams so there is no possibility of movement during the assembling of boiler parts and the building of inclosing setting.

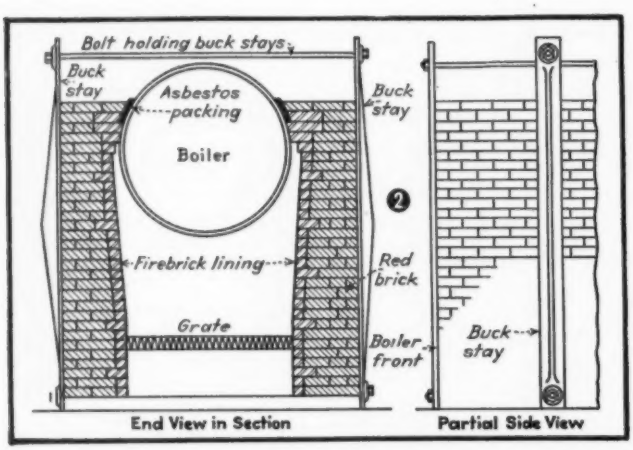
Q 9—Describe the solid-wall boiler setting.

A—This is probably the commonest form of setting wall construction in small and medium-sized boiler plants. Interior of the combustion chamber and furnace is lined with first-grade firebrick or a plastic refractory material made especially for this purpose. Outer wall is constructed of second-grade firebrick or a good quality of common red brick. The firebricks forming the furnace lining are not laid in mortar, but are merely dipped into a thin mixture of fireclay and water and rubbed into place so as to leave as thin a joint as possible. Common practice is to make the firebrick lining one brick thick, with a row of headers (bricks laid end-wise) every fifth or sixth row to bond the lining to the outer wall.

Bricks in the outer part of the wall are usually laid in a mortar of lime and sand, or of cement, lime and sand in the approximate proportions 1:1:5 by volume. Thickness of the setting walls depends on size of boiler and weight (if any) to be carried by the walls.

Plastic refractory material for furnace lining is supplied as a dry powder and mixed with water to the consistency of a stiff mortar before application. It is then plastered over the furnace walls

(*Continued on page* 164)



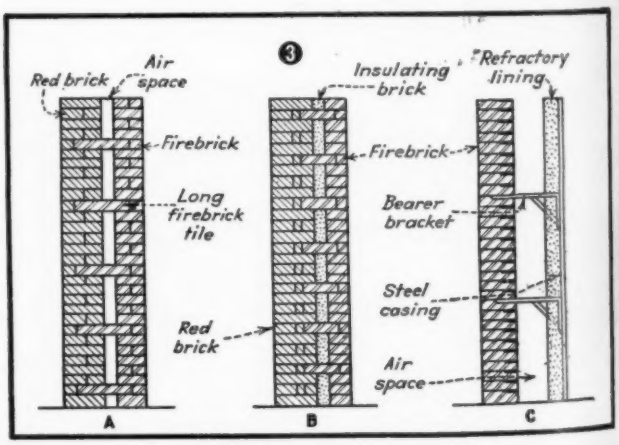


Fig. 2—Solid wall for hrt boiler. Fig. 3—A: wall with air space; B: wall with insulating brick; C: air-cooled wall

Compressor Shutdowns "Get the Air"

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HOW TO TEST UNLINED-LINEN FIRE HOSE

► ENGINEERS of the Consolidated Edison Co of New York recently inaugurated a special maintenance program to keep their fire hose in the best possible operating condition. The schedule includes periodic inspection, testing, cleaning, drying and repairing unlined linen fire hose. Special facilities are provided at one of the Brooklyn stations and hose from all other stations are brought to that central point for test.

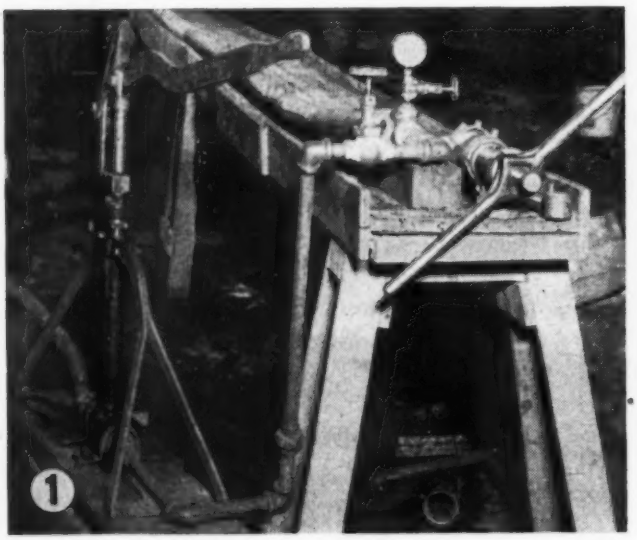
The program was adopted following 75-psi pressure tests that exposed weaknesses in hose obtained from various points on the system. Also, out of ten lengths of new hose taken direct from the stock room one length failed because of a local defect in fiber and weaving.

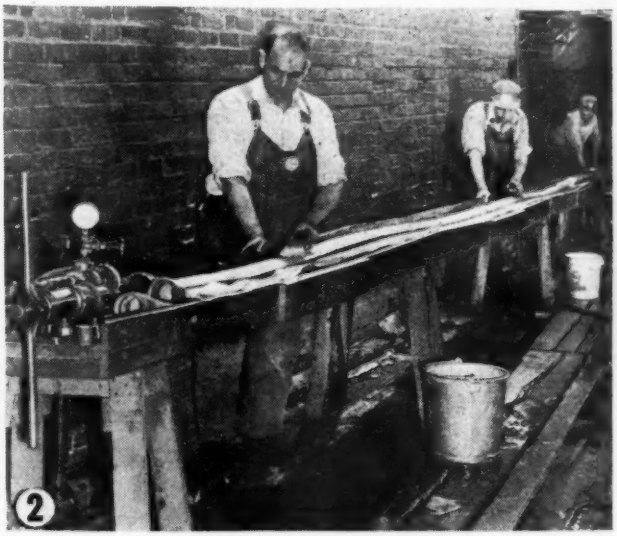
Approximately 10% of the tested lengths required repairs but this number undoubtedly will be reduced after all hose passes through inspection, giving assurance that it will always be ready when fire occurs.

To augment this intensive testing program, inspectors make a careful visual examination of linen hose monthly. Any section that appears damaged or in doubtful condition receives a hydrostatic test at a minimum pressure of 75 psi. The program contemplates annual testing of each length of hose on the system.

Every effort is made to protect hose against undue exposure to dampness which might result in mildew. Strict instructions are issued forbidding the use of fire hose for flushing down floors, wetting ashes or for any purpose other than fire protection.

A 3-man crew takes care of the tests.





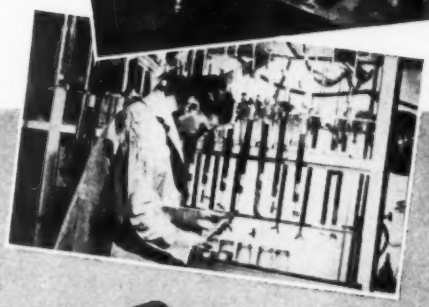
1 Hose checking equipment consists of a testing, cleaning and repairing table capable of accommodating three 50-ft lengths, hydrostatic test pump and coupling-ring expander for 1½- and 2½-in. hose. First operation puts hose under 75-psi pressure from hand-operated pump. Defective sections are cut out. Remaining good lengths, ten ft and over, get new couplings on their cut ends, making them again serviceable

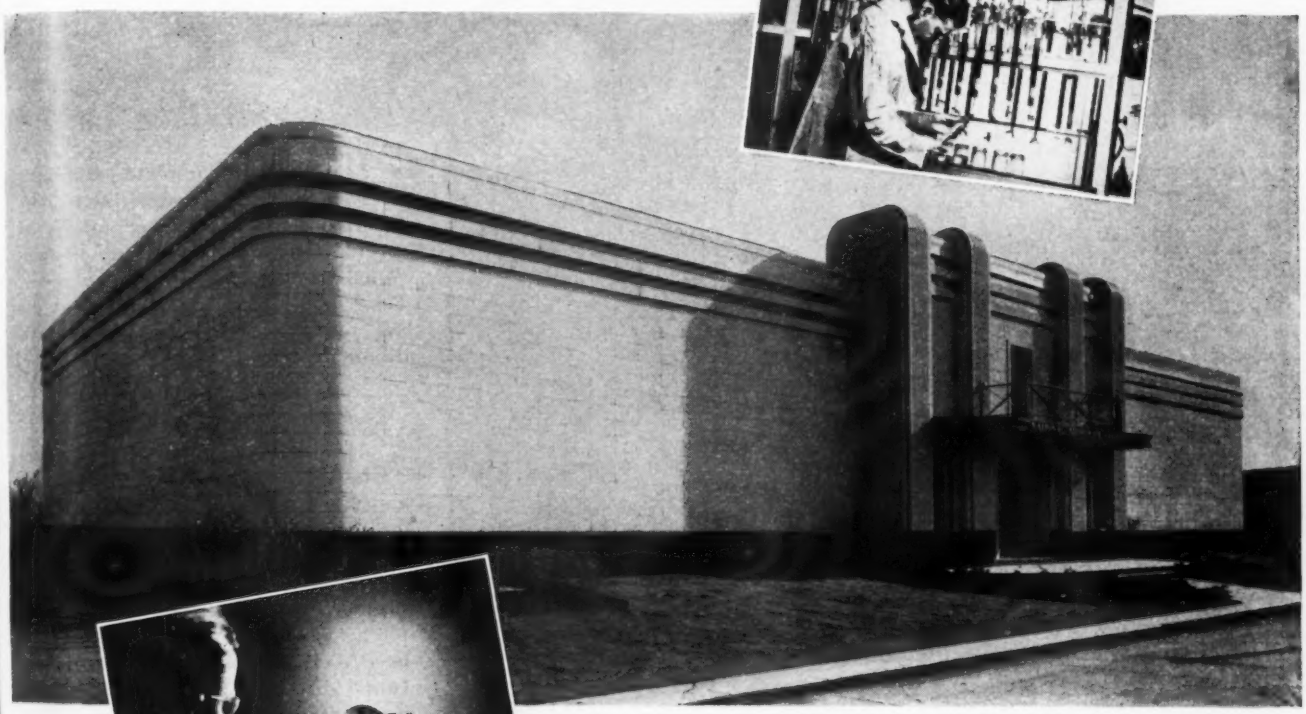
2 After passing the pressure test each length gets a thorough scrubbing with soft bristle brushes to remove dirt and stains. Washing solution is made of warm water and the finest grade of soap. Avoid strong alkali solutions

3 After a thorough scrubbing the hose is rinsed inside (A) and outside (B) with a fine water spray under 70-psi pressure. Rinsing removes loose dirt particles and flushes all soapy water out of the linen fibers

(*Continued on page* 122)

These WATER TREATMENT LABORATORIES, *Among the World's Finest*





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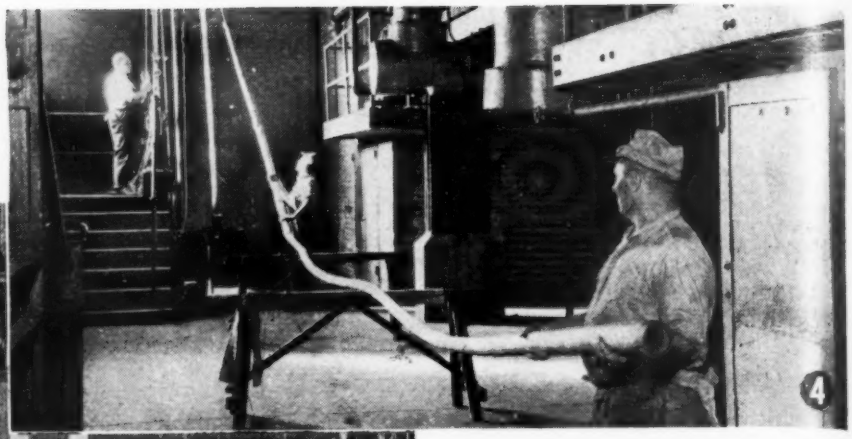
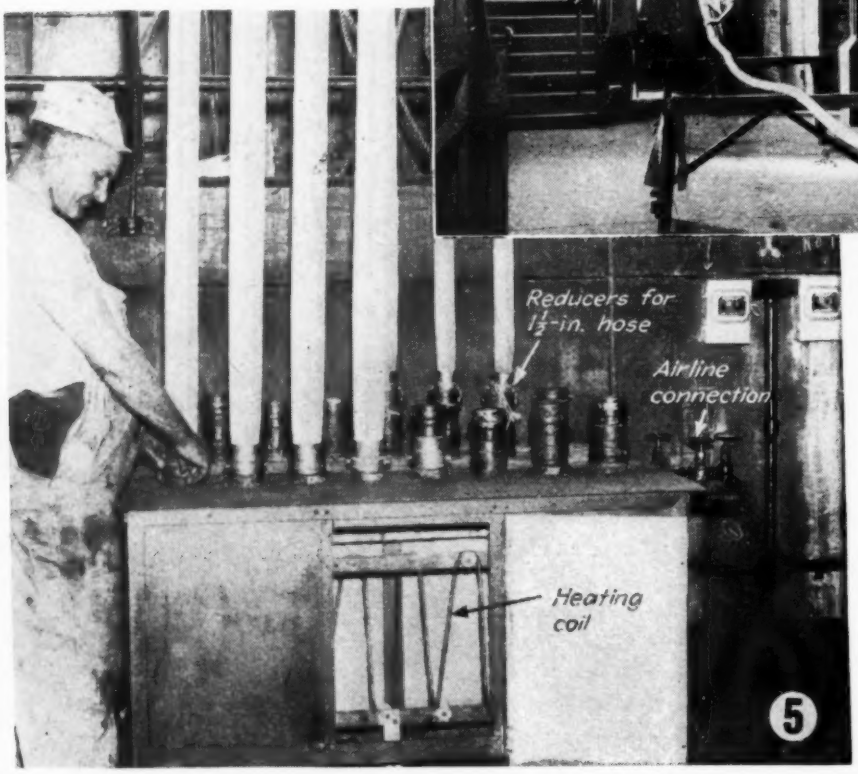
THE COMPLETE WATER TREATING SERVICE

HOW TO

TEST UNLINED-LINEN FIRE HOSE

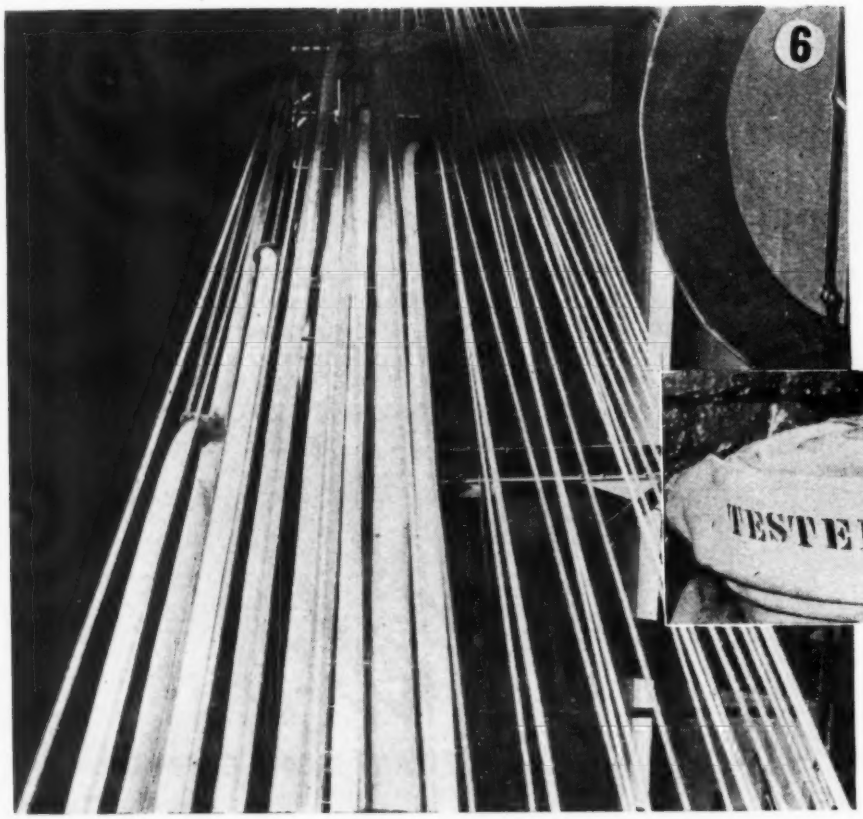
(Continued from page 120)





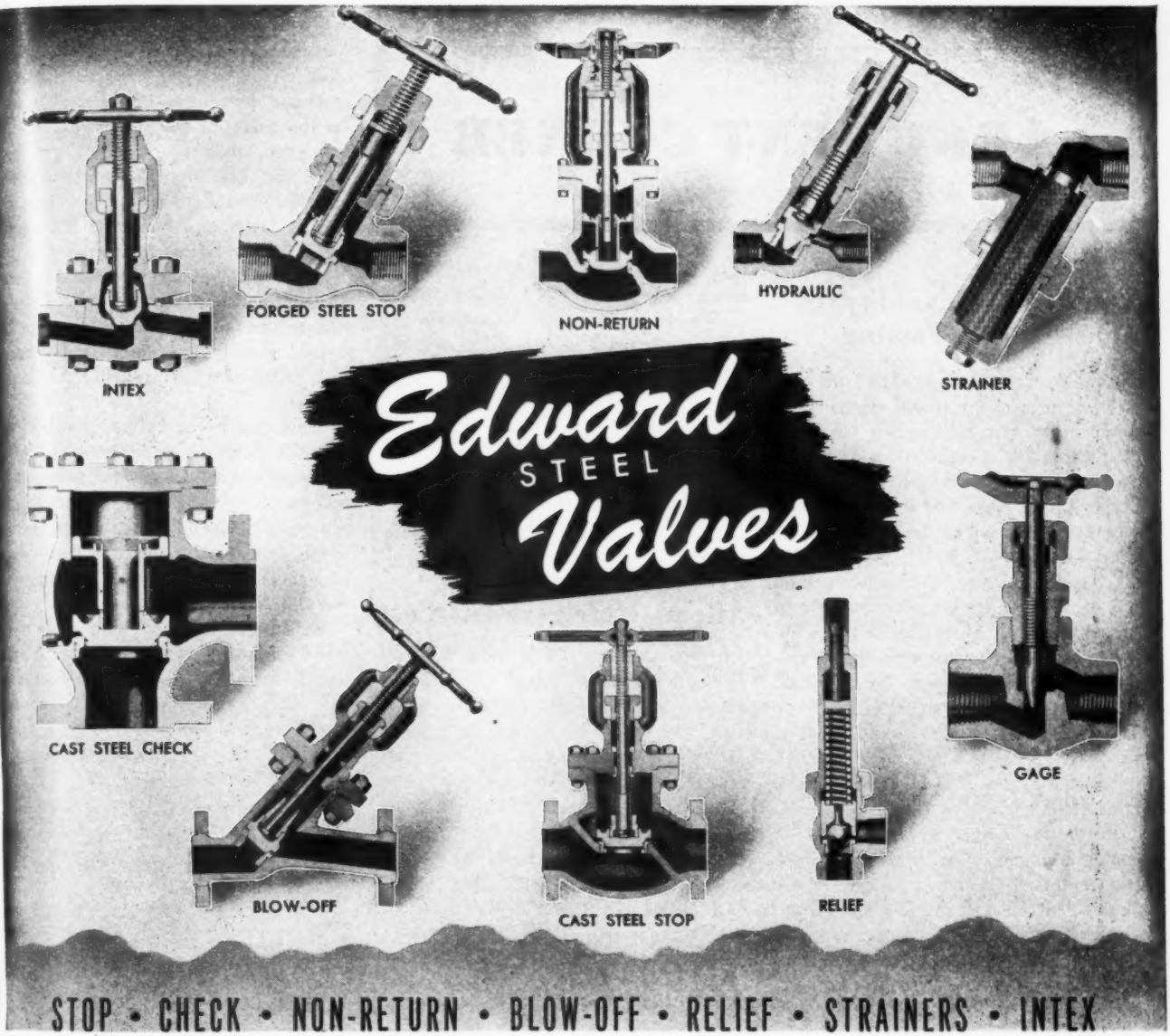
4 Prompt and complete drying is necessary to prevent linen hose from rotting. Consolidated Edison inspectors do this by stringing individual lengths in the drying tower. Take extreme care not to bend the wet rigid hose because, in this condition, it is easily damaged

5 After hose is hung, its lower end is connected to outlets (both 1½- and 2½-in. couplings are provided) on a drying oven designed and built by the company shop force. Electric heaters warm the air that circulates through the hose; compressed air, fed from nozzles that extend into the hose ends, assists hot-air circulation. Initial discharge at 80 psi inflates the hose after which the compressed-air pressure is reduced to 2 psi. Unused hose outlets are blanked off with caps



6 Initial drying continues for eight hours. At the end of this time each hose length is turned end for end and dried for an additional four hours. After the total 12-hour period, tests show that the water content of the fabric is no greater than that of brand new hose

7 After drying, each section receives a stencil record showing test date and over-all length. Standard racks are employed to hold fire hose at standpipe outlets; surplus rolled lengths lie horizontally on 4-in. skids



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ARGUMENT CORNER

Too Much Flexibility Causes Buck Passing

MANY MAINTENANCE REPAIR JOBS that overlap in mechanical and electrical responsibility can be handled efficiently only through the cooperation of the departments concerned. Sharply defined responsibility means less efficiency, whereas too much flexibility causes buck passing.

The plant electrician should work on a passenger or freight elevator only in an emergency. A regular monthly inspection by an elevator specialist is recommended. Adjustment of solenoid brakes is definitely an electrical job. The prime mover of the equipment is probably an electric motor and an electrical man makes adjustments in a more understanding manner than a machinist.

In most plants, machinists do the commutator and slipring work on electric motors but an up-to-date repair department should have its own lathe for turning and coil winding.

A machinist is required to repair any equipment for which the proper tools and machinery is provided. Usually, machinists do the shop work and mechanics the field work, but a certain amount of overlapping will be necessary.

Size of maintenance departments is not proportional to plant size as much as it is to the age and state of repair of the machinery. In most plants, size increase will not necessitate increasing the maintenance force because usually modern, trouble-free equipment is installed to replace older machinery.

Amherstburg, Ont. G O ELLIOTT

Power Demand Charge Affects Refrigeration Cost

IN THE ARTICLE, "Too Low a Head Pressure Can Cost Money," (Nov. 1943, POWER, p 103) which, by the way, is excellent, Mr Duryee uses the average rate per kwhr as a basis. Since most refrigeration loads in commercial plants are billed at rates that include a demand clause, it is well to consider the effect of that element when calculating effect of head pressure upon power cost. Thus, if the rate is based on the Wright maximum demand unit in which blocks in the rate are determined by the demand, or if the Block Hopkinson, or other such demand unit, is used, in which there is a demand plus an energy charge, then the average rate is not the proper basis of calculation of the power cost.

If the demand as established is used as the basis for the entire year, unless exceeded, then the time of the year must be considered. In the cooler months demand on the refrigeration system is lower and hence by letting the head pressures rise no increase in the basic demand element of the rate may result, in which case the cost of power due to the increased head pressure becomes merely the increased energy charge based upon probably the lowest rate step.

Then, too, in the hottest month of the year an increase in the demand due to economy in cooling water may result in an increased demand which affects power costs not only for that particular month but also for the next succeeding eleven, in which event the average rate is not the proper criterion.

Mr Duryee no doubt had these matters in mind but used the flat rate as a simple example to shorten his article. However, the reader should be cautioned against too much reliance upon averages and should be advised to apply the specific rate applicable.

Kansas City, Mo. B J GEORGE

Regarding Coal Savings

I AGREE WITH all of Mr Stilwell's article in December POWER, "This Winter We Fight with Coal," except his calculations as to fuel savings (page 140). When you increase boiler efficiency from 70% to 75% you save 6.67 tons of

(*Continued on page* 148)

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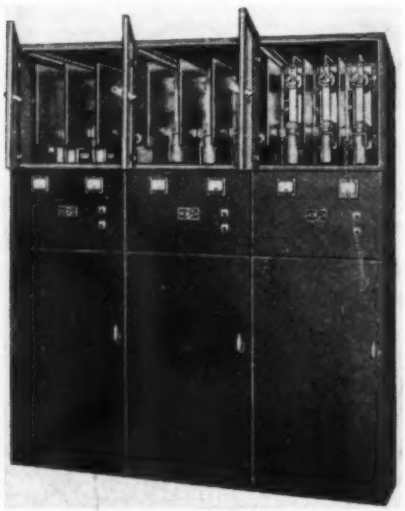
WHAT'S NEW IN PLANT EQUIPMENT

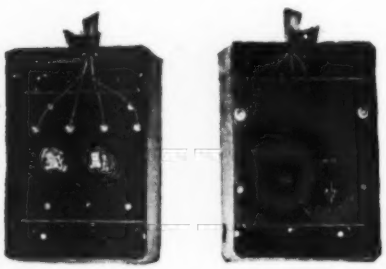


Fuse Control

E-M HI-FUSE CONTROL, for either synchronous or induction motors, combines dependable starting service with short-circuit protection by split-cycle operation. Fuses have high interrupting capacity. Polarized-field frequency relay controls application and removal of field excitation of synchronous motors. Furnished in live-front, dead-front and metal-inclosed model shown. *Electric Machinery Mfg Co, Minneapolis, Minn.*

Slide Rules

THREE NEW SLIDE RULES contain the scales A, B, C, D, CI, K, S, L and T. Professional draftsman and 5-in. pocket models are celluloid faced; apprentice rule has painted face. Rules equipped with case and instruction sheet. *Frederick Post Co, Box 803, Chicago 90, Ill.*



Bin-Level Indicator

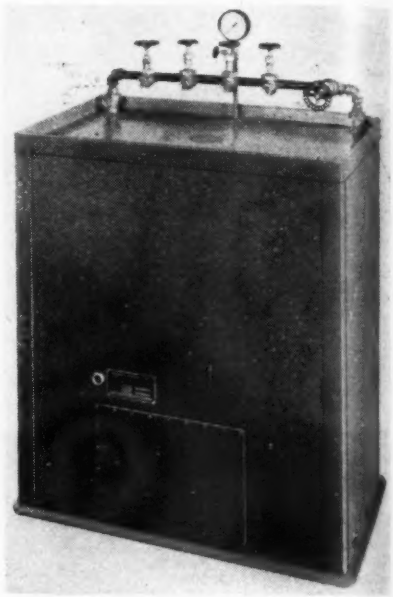
DRY-MATERIALS bin-level indicator operates on electronic principle. Device measures both fine and coarse material and consists of two parts. The first is a detector box, containing vacuum tubes, which is attached to a probe extending into bin. Second box is the signal control which is attached to colored lights that show when bin is full, empty, etc. Hookup with valve cutoffs, sound makers or remote signal devices may be arranged through appropriate relays. According to manufacturer, indicator gives a positive check on shipping and storage operations and therefore prevents material loss through spillovers, underfills, mistake or other miscalculation. *Mosher Electronic Control Systems, 130 W 42nd St, New York, N. Y.*

Air Blaster

FAN COOLS CONDENSERS, ammonia compressors and transformers. Unit consists of a heavy-gage welded-steel housing, mounted on an adjustable pedestal which may be tilted 60 deg, up or down. Fan driven by a direct-connected ball-bearing motor. Unit in three sizes: 18-in. ¾-hp, 6000-cfm motor; 24-in. 1½-hp, 9000-cfm motor; and 30-in. 1½-hp, 11,000-cfm motor. *Chelsea Fan & Blower Co, 1206 Grove St, Irvington, N. J.*

Hydraulic Test Bench

HY-MAC HYDRAULIC TEST BENCH T116 tests short lengths of hose or tubing, cylinders, etc. Bench for pressures up to 2000 psi. It consists of motor, pump,

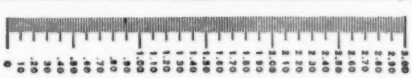


pressure-release valve, pressure shutoff valves, pressure and oil-level gages, filters and baffles. Bench is 40-in. high and its base dimensions are 21x38 in. *Hydraulic Machinery, Inc, 12825 Ford Rd. Dearborn. Mich.*

Weld-Bend Test Scale

TEMPILSCALE FOR WELD-BEND tests, in 3x6 in. 25-sheet pad form, is not only a substitute for flexible steel rule but, according to manufacturer, can be more readily applied to sharply curved surfaces. Face of each sheet has space for

(*Continued on page* 136)



TEMPILscale for WELD BEND TEST

Bar mark_____ Welder_____ Elongation required 20% ☐ 30% ☐

DISTANCE BETWEEN SCRIBE MARKS
- Before bending = _____
- Minimum for required elongation _____

See table on other side

ACTUAL RESULTS

After bend _____"
Before bend _____"
Difference _____"
% Elongation _____%

REMARKS _____

TESTED BY _____ INSPECTED BY _____

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CRANE VALVES

TURBINE SONG . . .

DOWN by the river the turbine sits,
On a ponderous concrete throne,
And he sings to himself as he rules the world,
In a thunderous monotone.

"I drink the river's flow at a draft.
My food is fiery steam.
A storm wind cools my driving might,
As I make the lightning's gleam.

"My arms reach forth a hundred miles,
Where the long black steel mill stands,
To crush the glowing ingot's bulk,
Like dough in the baker's hands!

"On the grudging ore I blow my breath,
To set the shining metal free.
With crashing hammer and groaning press,
I strike a mighty symphony!

"I grind the cam and forge the crank,
And speed the spindle and loom.
With blazing lights o'er the countryside,
I shatter the midnight gloom!

"I hurry the lathe and boring mill,
On propeller and tank and gun,
And I shall bind the wounds of war,
When victory is won!

"I bring the news from the ends of the earth,
I soothe and entertain.
I find the hidden malady,
And bring relief from pain.

"I am servant and monarch of all mankind,
And the master of the hour.
I am the force that moves the earth,
For I am electric power!"

—John S. Kernachan

Mr. Kernachan has pictured, in "Turbine Song,"* the vital part that power plays in our modern existence—its place in industry, in commerce, in life itself, whether in war or in peace. It is a privilege and a pleasure for me to bring this poem to you.

George Edwards
Engineer

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FOR over 25 years, engineers have depended on Johns-Manville Service Sheet for their gaskets. As a result of its performance under widely varying temperature and pressure conditions against steam, oil and other fluids, gases and chemicals, J-M Service Sheet is recognized as the No. 1 sheet packing today.

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POWER LINES

Personal notes, items of general interest, the latest from Washington — all the news that is news in the power field

Emergency Power Plant

A wartime power plant of 5000 kw on eight railroad cars can be used all over the world—even in devastated regions to deliver water. It operates on poor grades of coal and can deliver power in about 48 hr after arriving at site, according to Westinghouse engineers. It works in temperatures from 110 above to 40 deg below zero.

Cars 1 and 2 carry air-cooled condensers; car 3, turbine-generator with switchgear equipment; cars 4 and 5, auxiliary equipment and water storage (the latter runs the train under severe conditions more than a full day without replenishment); cars 6 and 7 are for the boilers; 8 has quarters for crew and lubricating-oil storage, spare parts, etc.

The two boilers produce steam at 600-psi gage, 750 F from available coals—even lignite with heat content of only 7000 Btu per lb. Boilers are water-tube, double-drum, have both forced and induced draft fans and air-operated locomotive-type stokers. The single turbine-generator unit delivers to the bus 6250 kva at 80% pf, 6300 v. A diesel-driven generator provides 75-kw capacity for plant and auxiliary purposes.

Four motor-driven propeller fans draw air over eight coolers in each condenser car. Even with cooling air at 95 F, condensers can condense full amount of steam; condenser water is then pumped back to the feedwater tank car. Thus, less than 3% makeup water is filtered, softened and evaporated in the auxiliary car.

Safety Research Institute has this to say regarding distinction between fire-extinguisher labels: **Standard approved extinguisher** label reads "Underwriters' Laboratories Inspected," and has serial number and pertinent classification information. It signifies that unit conforms to Laboratories pre-war specifications covering types of materials, details of construction, performance requirements, etc. Available now only to very high priority holders. **Emergency Alternate Specification** permits use of substitute non-critical materials. This label, bearing EAS approval and year of manufacture, translated into practical terms, signifies that the unit on which it appears will perform as well as standard model but requires more care-

(*Continued on page* 184)

War Manpower Commission and War Production Board have announced a cooperative program for more effective labor recruiting for locally needed civilian services and industries producing essential civilian goods. WMC State, regional and area representatives will consult with those of WPB's Office of Civilian Requirements on **employers' labor needs.**

As a basis of such field relationship, OCR will make recommendations on production of essential civilian goods and locally needed services through WPB representatives on Area Manpower Priorities Committees, and where such committees have not been established, directly to the area of State WMC offices.

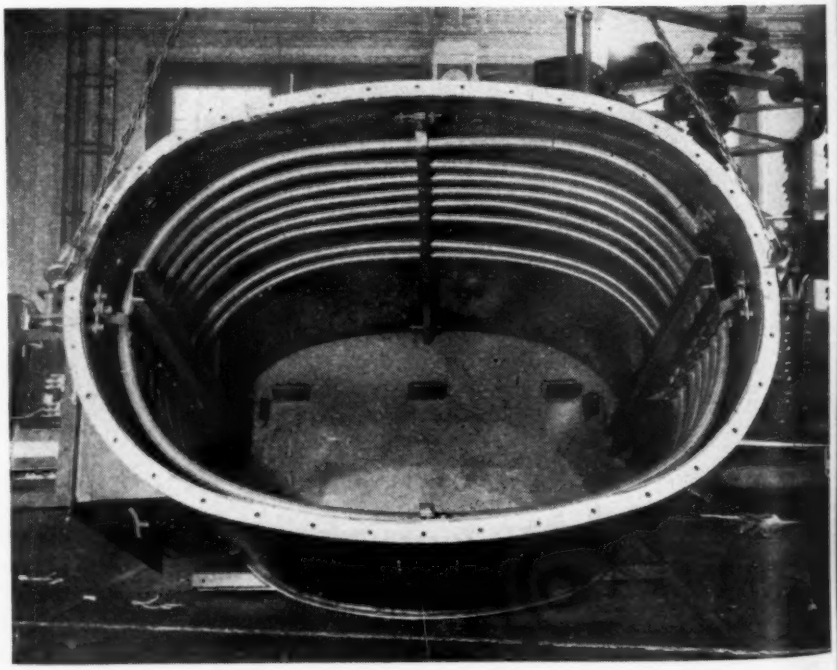
○ ○ ○

Canada faces a coal shortage this winter of about 20%, as follows: (1) reduction in mine output because many miners have joined the armed forces, (2) reduction in output of U. S. mines will reduce U. S. exports to Canada, (3) increased coal requirements by armed forces, munitions, industries, etc, which are not offset by reduction of coal for non-essential industrial use.

○ ○ ○

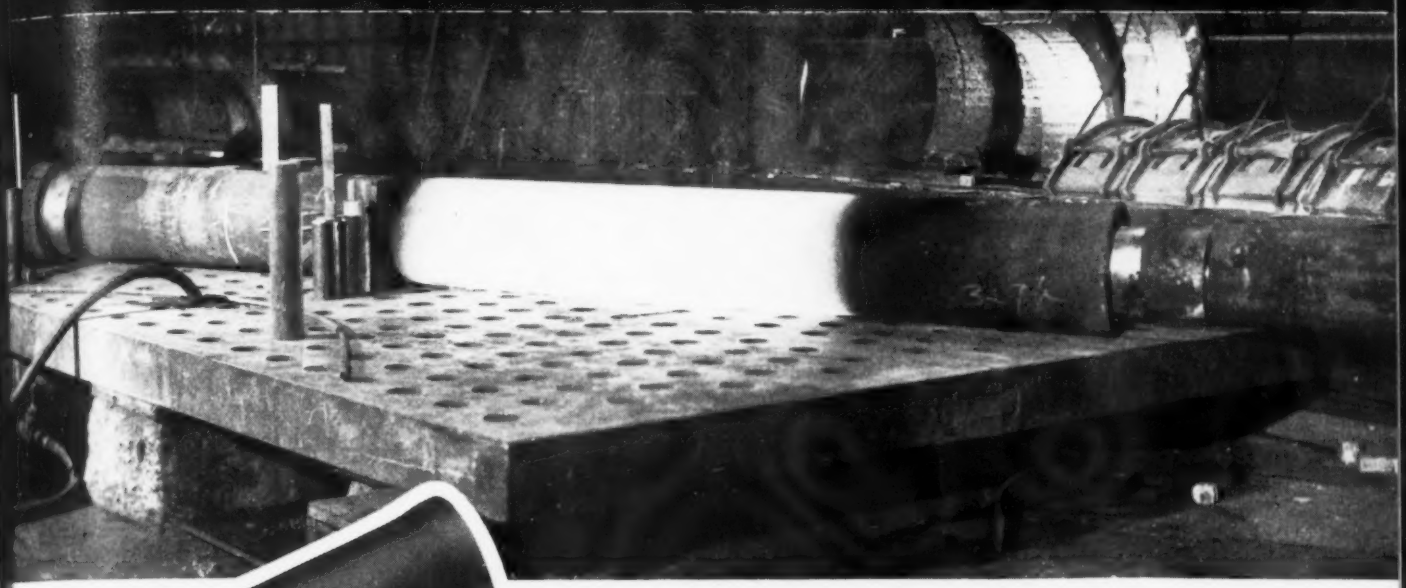
The Society of Chemical Industry, American section, announced the election of **Gaston F DuBois,** vice-president, Monsanto Chemical Co, to receive the Perkin Medal for his outstanding work in applied chemistry. Presentation was made Jan 7 at a dinner meeting of the Society in New York. Mr DuBois, the 38th chemist to receive the medal, was graduated in Zurich, Switzerland, from the Federal Polytechnic and afterwards specialized in electrochemistry at Technische Hochschule in Dresden. Coming to America in 1904, he accepted a position with the Monsanto Chemical Co. Since that time he has contributed to practically every technical development of the company and of its subsidiaries.

WROUGHT IRON PINCH-HITS FOR COPPER



Restrictions imposed on copper pipe for cooling coils have forced manufacturers of electrical transformers to find capable substitutes. The casing shown above, made by the Pennsylvania Transformer Company, Pittsburgh, uses 1¼-inch standard black plain-end wrought-iron pipe. Wrought iron was selected because it resists corrosion and is readily bent and welded

HE SCIENTIFIC APPROACH TO YOUR PIPING PROBLEMS



Some of the many operations taking place under rigid engineering control which are standard practice in Power Piping Division. These practices provide better piping to meet the wartime need for speed, quality and economy.

1—Strict furnace control with optical pyrometer during heating preceding bending operations.

2—Annealing to improve grain structure.

3—End preparation for welding.

4—Preheating and maintenance of heat during welding.

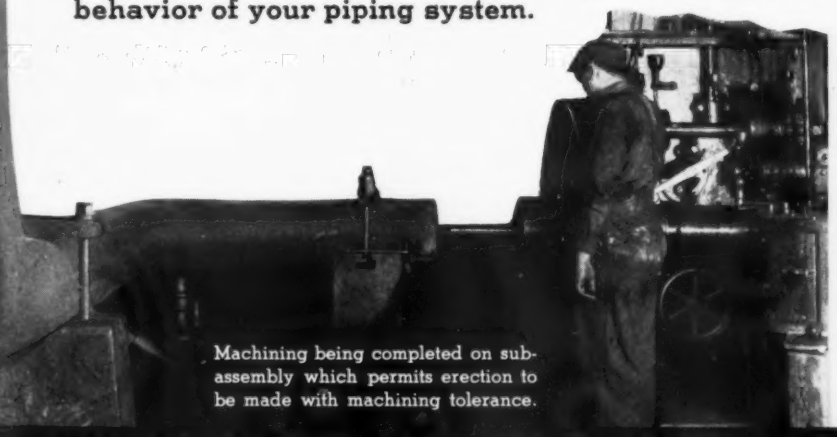
5—Welding . . . cleaning . . . chipping.

6—Stress relieving welded joints to restore grain structure.

7—Sub-assemblies aligned and finished to specification.

8—Hydrostatic testing and inspection.

Highly developed procedures provide economical erection. Power Piping Functional Hangers and Vibration Eliminators adequately control the behavior of your piping system.

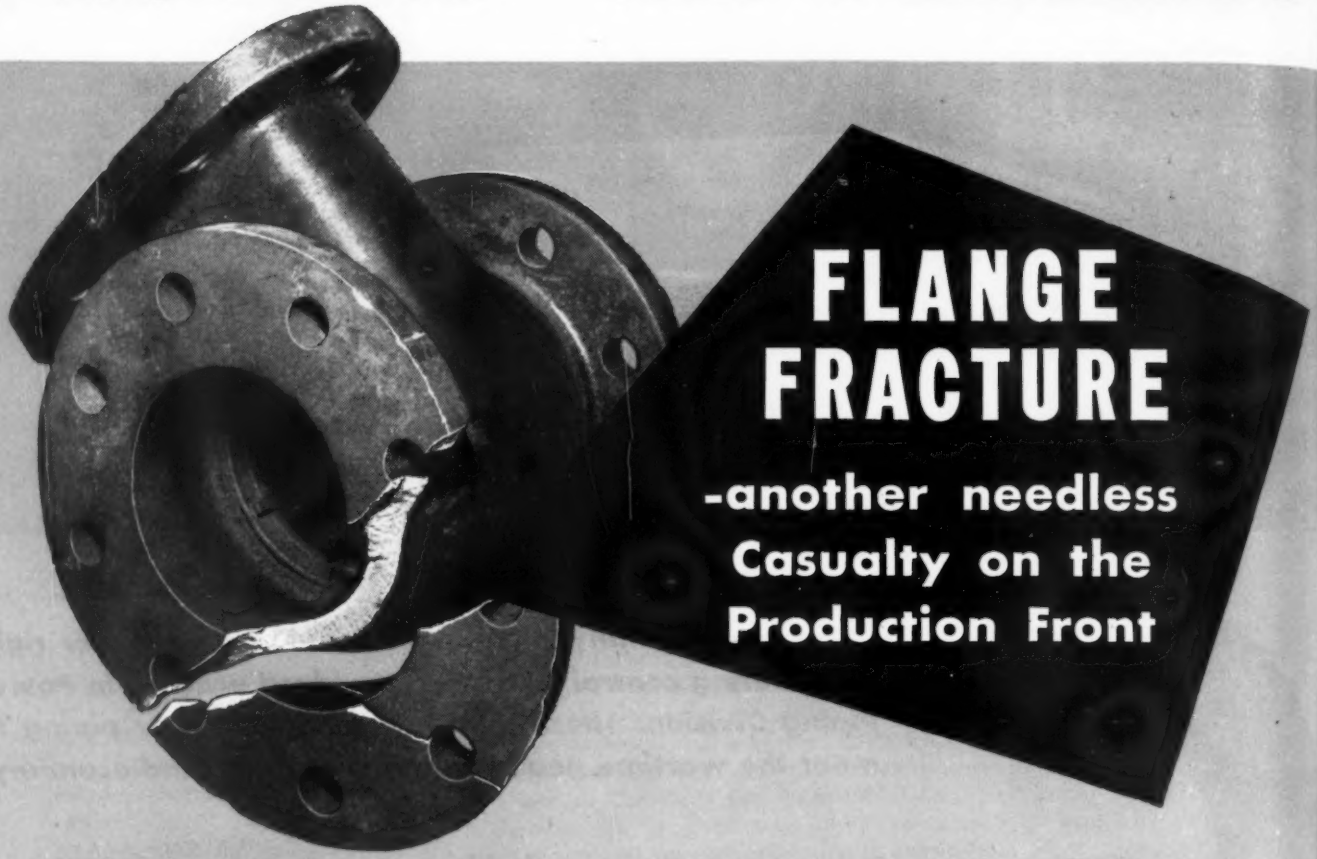


Machining being completed on sub-assembly which permits erection to be made with machining tolerance.

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

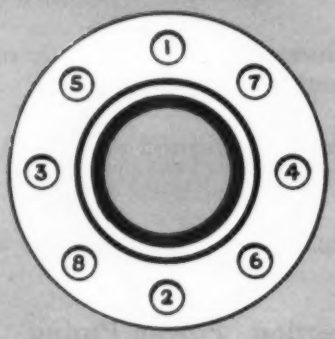
The correlated use of FLEX-ANAL CHARTS and HANGER BULLETIN 1863 saves time in engineering man power which can be devoted to other useful purposes. Copies of these books can be obtained through a request on your business letterhead.

Prevent Valve Failure



FLANGE FRACTURE

-another needless Casualty on the Production Front



KEEP TENSION EQUALIZED WHEN TIGHTENING BOLTS

First set all nuts hand tight. Next, tighten nuts opposite each other equally, as indicated, but not to final tension. Then tighten up the nuts by working around the flange, giving each consecutive nut a pull at a time until the desired tightness is attained.

Flange fracture is almost invariably the result of unequalized strains set up by improper make-up and tightening of joints. If the heavy bolt load necessary to keep the joint tight is not carefully balanced, and if the wrong type of gasket is used, the resistance of the flange to the punishing stresses of expansion, or to shocks, is greatly limited. When cracks and fracture develop, another valve goes out of service.

Shut-downs for replacement or repair create expensive delays at any time, and today they often interrupt the production of war material urgently needed to speed Victory. Such needless failure and waste of critical metals can and should be prevented.

See that new valves are carefully selected, and installed by men who thoroughly understand the work . . . also, that maintenance men are well instructed and provided with the proper tools and equipment. Set up a system of frequent valve inspection, and see that worn parts are repaired or replaced in time to prevent valves from destroying themselves.

Jenkins Engineers will assist any management in preparing an effective program of valve conservation.

Jenkins Bros., 80 White Street, New York, 13, N. Y.; Bridgeport, Atlanta, Boston, Philadelphia, Chicago. Jenkins Bros., Ltd., Montreal; London, England.

Jenkins Bros.

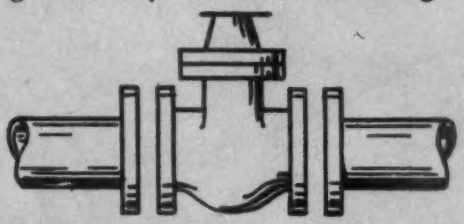
JENKINS VALVES

before it starts!

SAVE FLANGES... Avoid Shutdowns with these Simple Precautions

Don't "Stretch the Pipeline"

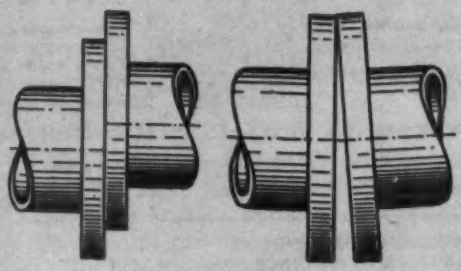
When the space between the pipe-ends in a line is wider than the face-to-face dimensions of the valve to be installed, don't try to "stretch the pipeline" by drawing the ends to the valve by tightening the bolts. Install a metal spacing flange. Never try to fill in with a thicker gasket.



See that Flange Faces are Smooth, True

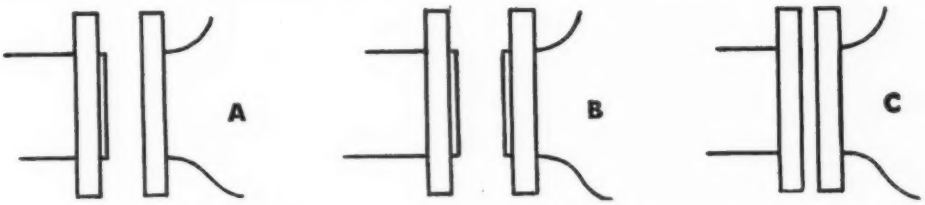
Make sure that the surfaces to come in contact are free from foreign matter.

Line up Flanges before Bolting



A frequent cause of stresses destructive to flanges is poor alignment of piping, as illustrated. Don't try to "spring" flanges into line. When an assembly results in misalignments like those shown above, correct the condition by checking back to the source of the trouble.

HOW TO SELECT THE CORRECT GASKET



A and B *Iron to Iron, or Iron to Steel, with a raised face on either or both flanges.* Use a *ring* type *asbestos* gasket that fits neatly inside the bolts. This material is necessary to withstand the increased pressure due to the reduced area of the contact surfaces between the flanges.

C-1 *Bronze to Bronze, with plain full-faced flanges.* Use a *full-face* gasket, made of material* to suit the service.

C-2 *Iron to Iron, with plain full-face flanges.* Use either a *full-face or ring* type gasket, of material* to suit the service.

C-3 *Iron to Bronze, with plain full-face flanges.* Use full-face gasket, of material* to suit the service.

* The wide range of gasket materials, normally from soft rubber for cold water to steel rings for high pressure steam, is currently restricted because of war conditions. It is advisable to obtain complete recommendations for the service from gasket material makers.

For every industrial, engineering, marine and power plant service

BRONZE ★ IRON ★ STEEL

Number 138

Brush Operating Faults and Remedies—II

INDICATIONS OF UNSATISFACTORY PERFORMANCE AND THEIR SOURCE

INDICATIONS APPEARING AT BRUSHES	IMMEDIATE CAUSES	PRIMARY FAULTS*
Flashover at brushes	Machine condition	14–35
	Bad load condition	38–39–41–52
	Lack of attention	5–11
Chattering or noisy brushes	Commutator surface condition	See specific surface fault in evidence
	Looseness in machine	15–16–17
	Faulty machine adjustment	10–11
	High friction	43–45–49–51–57–58
	Wrong brush grade	54–57–58
Brush chipping or breakage	Commutator surface condition	See specific surface fault in evidence
	Looseness in machine	15–16–17
	Vibration	51
	Chattering	See "Chattering brushes"
	Sluggish brush movement	14
INDICATIONS APPEARING AT COMMUTATOR SURFACE		
Rough or uneven surface		1–2–3–4–17
Dull or dirty surface		5–44–59
Eccentric surface		1–19–22–51
High commutator bar		17
Low commutator bar	Sparking	2–25
Streaking or threading of surface	Sparking	43–44–45–46–49–58
	Copper or foreign material in brush face	2–3–46–47–48–60
	Glowing	*See "Glowing at brush face"
Bar etching or burning	Sparking	2–3–7–12–30–31–32–33
	Flashover	5–11–14–35–38–39–41–52
Bar marking at pole pitch spacing	Sparking	25–37
Bar marking at slot pitch spacing	Sparking	7–12–30–56–59
Flat spot	Sparking	19–23–25–41–42–52
	Flashover	5–11–14–35–38–39–41–52
	Lack of attention	1–5–11
Discoloration of surface	High temperature	See " Heating at commutator"
	Atmospheric condition	44–46
	Wrong brush grade	59
Raw copper surface	Embedded copper	*See "Copper in brush face"
	Bad service condition	43–45–47–49
	Wrong brush grade	58–60
Rapid commutator wear with blackened surface	Burning	2–3–11–14
	Severe sparking	*See "Sparking"
Rapid commutator wear with bright surface	Foreign material in brush face	43–45–47–49
	Wrong brush grade	60
INDICATION APPEARING AS HEATING		
Heating in windings	Severe load condition	38–41–42–52
	Unbalanced magnetic field	18–19–20–21–27–28–29
	Unbalanced armature currents	8–19–22–25–27–28–29–37
	Poorly equalized parallel operation	7–13–23–34
	Lack of ventilation	6
Heating at commutator	Severe load condition	38–41–42
	Severe sparking	7–8–9–12–20–33–45–56
	High friction	10–11–36–43–45–49–57–58
	Poor commutator surface	See specific surface fault in evidence
	Depreciation	24
	High contact resistance	55
Heating at brushes	Severe load condition	38–41–42
	Faulty machine adjustment	7–10–11–12–26
	Severe sparking	*See "Sparking"
	Raw streaks on commutator surface	See "Streaking or threading of surface"
	Embedded copper	*See "Copper in brush face"
	Wrong brush grade	56–57–58–60–61

* For references see Part I, page 138, January POWER.

Courtesy, National Carbon Co

© POWER

ONLY *Flowmatic* OFFERS ALL THESE ADVANTAGES

Performance records confirm the Copes Flowmatic Regulator as the outstanding development in Boiler Feed Water Control.

Here's why--

Read the interesting 5-year performance record of Copes Flowmatic, summarized in the folder "No Two Boilers Are Alike." Furnished free, together with descriptive catalog, upon request for Bulletin 429A.

1. Copes Flowmatic varies the rate of feed in proportion to changes in steam flow, with secondary compensation from boiler water level.
2. Maintains boiler water level within extremely close limits—minimizes effect of "shrink" and "swell."
3. Eliminates danger of burned tubes due to low level, or carry-over due to high level.
4. Flowmatic saves fuel—decreases maintenance. Instant and correct response to every demand provides optimum feed conditions for boilers, economizers, heaters and pumps.
5. Increases boiler capacity; gives more uniform steam pressures.
6. Reduces tendency to swap loads among boilers of a battery.
7. Copes Flowmatic usually eliminates the necessity of differential pressure control.
8. Lower first cost and maintenance than other systems for similar service.
9. Can be installed, adjusted, and cut into service by plant personnel. Not dependent on factory specialists.
10. Adjustable for any desired water level characteristic—falling, constant, or rising with load.
11. Flowmatic is fully automatic and is independent of other control systems.
12. Thoroughly dependable, built for continued hard usage with no more than routine care and inspection.
13. Available in both direct operated and relay operated types.
14. Flowmatic is a Copes Product—symbol of pioneering and leadership in feed water regulation.

NORTHERN EQUIPMENT COMPANY
241 GROVE DRIVE • ERIE, PA.

Feed Water Regulators • Pump Governors • Liquid Level Controls • Differential Valves • Reducing Valves and Desuperheaters

Branch Plants in Canada, England — Representatives Everywhere

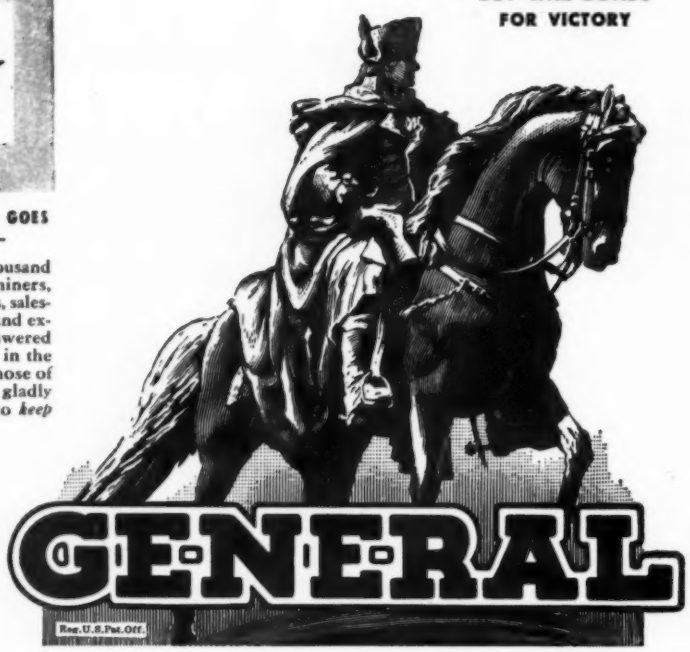
★ **GET CLOSER LEVEL-CONTROL WITH THE** COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

GENERAL COAL GOES TO WAR—

More than a thousand of our men—miners, machinists, clerks, salesmen, engineers and executives have answered the call to serve in the armed forces. Those of us left behind gladly "Close Ranks" to *keep the coal rolling.*

BUY WAR BONDS FOR VICTORY



GENERAL

Reg. U.S. Pat. Off.

RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

IDENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE—Hazle Brook Premium . . . Raven Run

Our personnel with the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

General Coal Company

123 SOUTH BROAD STREET **PHILADELPHIA, PA.**

BRANCHES:

BLUEFIELD, W. VA. BOSTON BUFFALO CHARLESTON CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH

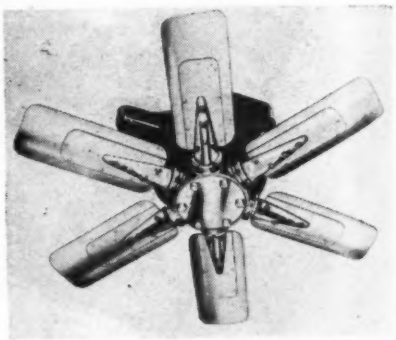
New Equipment

(*Continued from page* 126)

permanent record of test data, while the back has a table of figures giving required elongation. Write direct on company letterhead for free pad. *Tempil Corp, 132 W 22nd St, New York, N. Y.*

Flaring Tool

COMPLETE TOOL consists of flaring bar, yoke with swivel cone and four adapters furnished in metal kit. No. 175-FP multi-sized double-flaring tool handles plastic tubing of 3/8, 1/2, 5/8 and 3/4 OD. While designed for .062-in. wall tubing, it also handles .031-in. *Imperial Brass Mfg Co, 1200 W Harrison St, Chicago.*



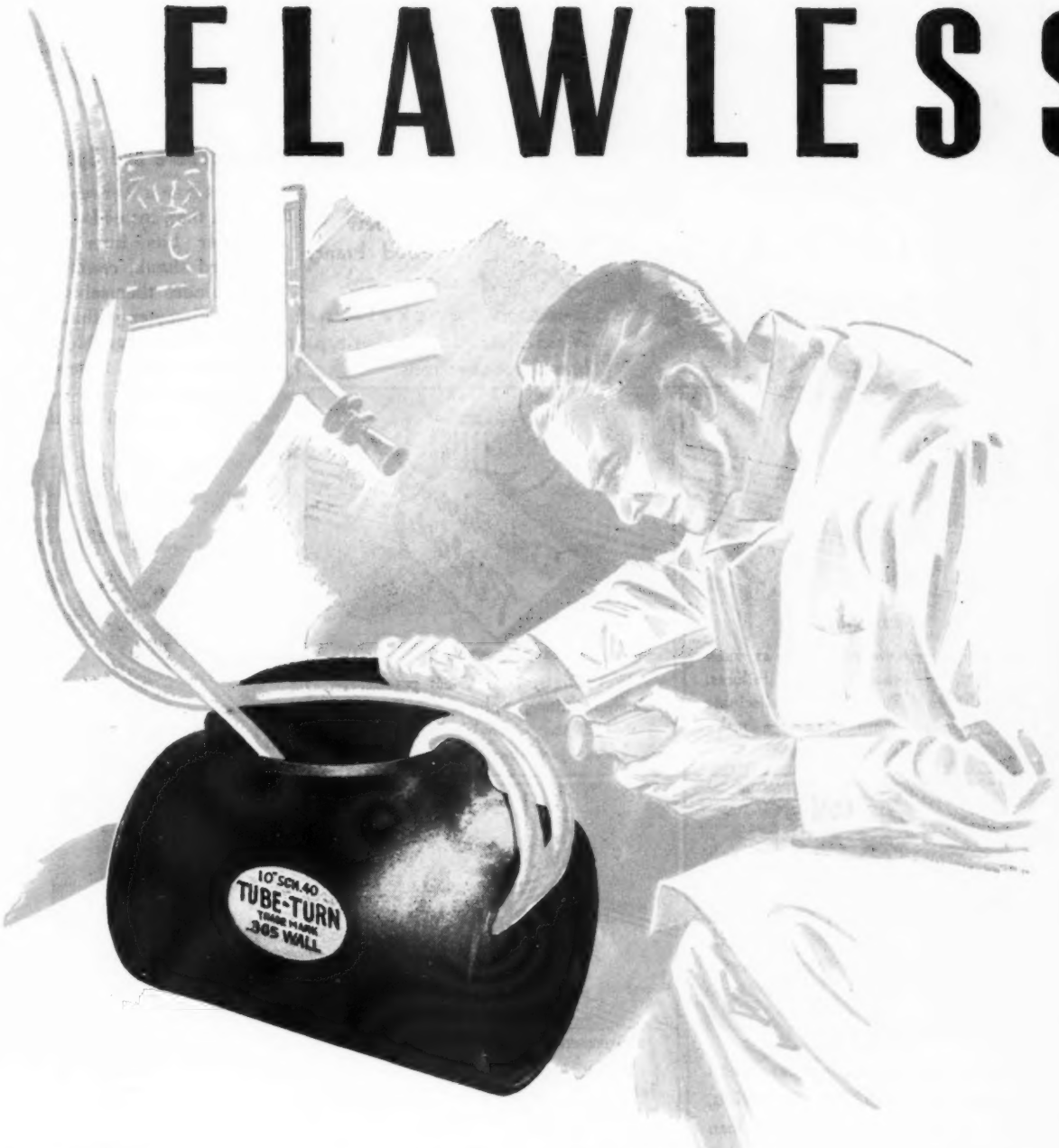
Fan Unit

CONTROLLABLE-PITCH blade fan kit, for gasoline, natural-gas and diesel engines, may be installed in heavy, engine-powered industrial equipment and is applicable to other cooling jobs requiring automatic thermostatic control. In latest model, controlling thermal element is direct connected through fan spindle to blade-turning mechanism, said to produce an extremely compact assembly. *Kontrol Fan, Inc, 4031 Goodwin Ave, Los Angeles 26, Calif.*

Tachometer

SMALL GENERATOR, coupled electrically to electric meter, has permanent Alnico magnet rotor mounted on precision-sealed ball bearings and capable of continuous operation at any speed within meter limit. Indicating instrument, a rectifier type, capable of withstanding momentary overload up to four times maximum-speed indication without damage. Switch provides easy changing from high to low range. Generator and meter made as separate elements and coupled by bayonet lock. Units may be used together as a hand tachometer, or may be separated and

FLAWLESS



THE MAGNAFLUX TEST, shown above in Tube Turns' laboratory, quickly reveals any hidden defects in the finished product.

***Flawless* welding fittings are even more essential than perfect pipe. For extreme velocities, high pressures, vibration, strain, corrosive wear are *most* destructive to piping systems where flow changes direction . . . *at the fittings!* Defective fittings can cause leakage, breakdowns, unnecessary maintenance and can disrupt imperative production schedules.**

Tests to *insure* flawless fittings have been, are today and will be a permanent Tube Turns' policy.

TUBE TURNS (Inc.) Louisville, Kentucky. *Branch Offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle . . . Distributors located in all principal cities.*

ARMY E NAVY M

TUBE-TURN

TRADE MARK

Welding Fittings and Flanges

Make Good Piping Better

with

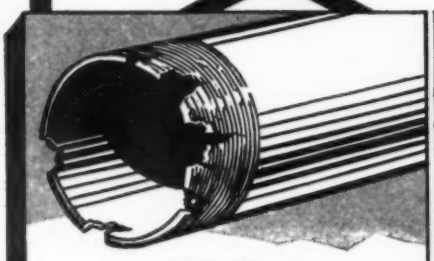
WELDOLETS · THREDOLETS

3 Types Meet Every Need

WeldOlets for butt welded branch connections.

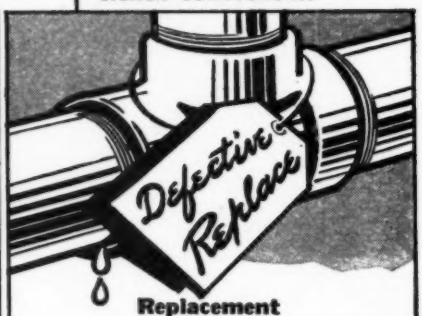
ThredOlets for screwed branch connections.

Socket-End WeldOlets for socket-type branch connections.



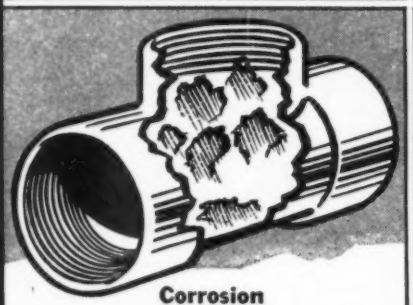
Threading

Threading weakens pipe walls as much as 40% — causes piping failures. WeldOlets, ThredOlets, eliminate threading of main pipe — make junction of full pipe strength.



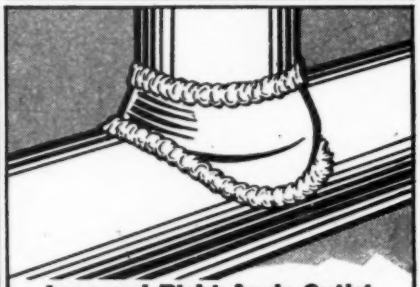
Replacement

WeldOlets, ThredOlets practically eliminate fitting replacement. Properly installed they provide trouble-free, leakproof junctions.



Corrosion

Because drop forging improves metal structure of WeldOlets, ThredOlets, they resist corrosion better than ordinary types of fittings.



Improved Right-Angle Outlet

WeldOlets, ThredOlets provide leakproof, right-angle branch pipe outlets of full pipe strength; improve flow conditions; eliminate worn threads; bolt tightening; reduce need for fitting replacement; corrosion.

WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for all commonly used pressures and temperatures in every type of piping system. They are installed either before or after erection of the main line and always with ease and economy. They are equally well adapted to prefabricated or "on-the-job" assemblies. Their patented, funnel-shaped intake aperture improves flow conditions, reduces turbulence and friction.

Carried in stock for all standard pipe sizes up to 12" in size-to-size and reducing sizes—up to 24" on special order. Stock fittings are drop forged steel, but to meet unusual conditions can be supplied in Monel, Everdur, Toncan Iron, wrought iron, etc.

Bulletin WT31 gives detailed information about all the advantages of WeldOlets, ThredOlets and Socket-End WeldOlets. Write for a copy today.

Forged Fittings Division

Bonney Forge & Tool Works, Allentown, Pa.

WELDOLETS ·

TRADE MARKS · REG. U.S. PAT. OFF.

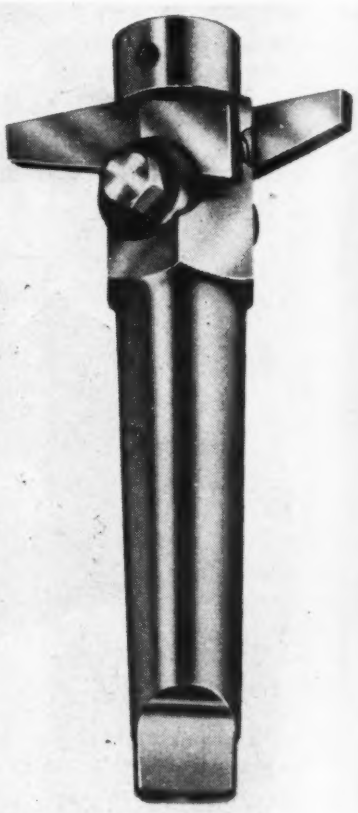
THREDOLETS

Welded Outlets for Every Piping System

connected by 2-conductor electric cord. Tachometer in 2 sizes for 0 to 2500 rpm and 0 to 5000 rpm. *Ideal Commutator Dresser Co, Park Ave, Sycamore, Ill.*

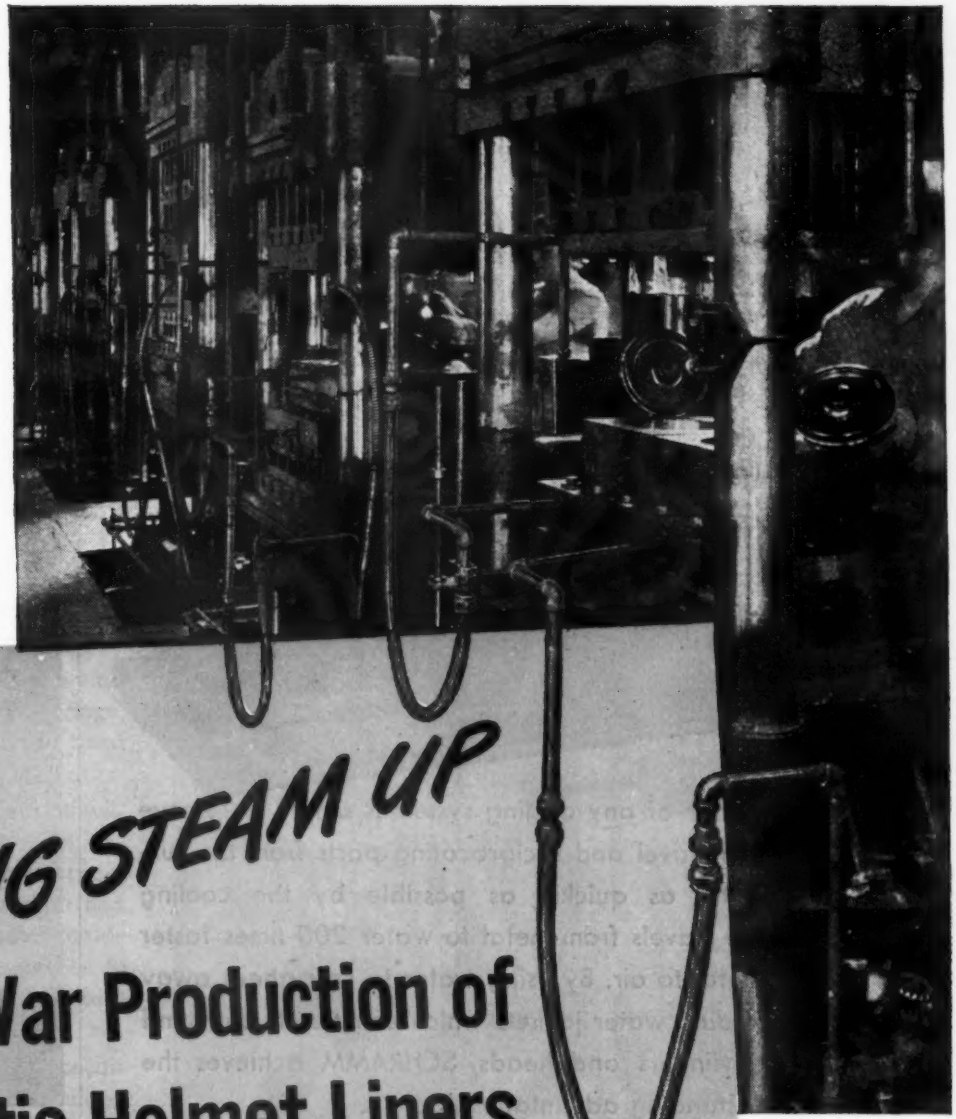
Counterbore and Spotfacer

DIFFERS FROM conventional adjustable tools in that, instead of a group of fixed-diameter bits interchangeable on a standard shank, counterbore and spotfacer blades themselves are adjustable to any diameter within broad limits of tools. Interchangeable pilots designed to prevent burrs forming at pilot-hole edge. Eight sizes of counterbore and spotfacer cover all fractional and decimal diameters from $\frac{7}{16}$ to $5\frac{1}{2}$ in. and provide interchangeable pilots from $\frac{1}{4}$ to $5\frac{1}{4}$ in. dia. Tools for engine lathes, milling machines, drill presses, turret lathes, jig borers, boring mills, automatic screw machines and for spindle machines which can use a boring bar. *Robert H Clark Co, 3424 Sunset Blvd, Los Angeles 26, Calif.*



Mercury Searchlight

AIR-CONDITIONED searchlight, in 12- 18- and 24-in. dia, comes in variety of mountings. Light source is a midget capillary 900-w mercury lamp, which throws flat, concentrated beam capable of illuminating distant horizontal surfaces from low mounting height. Measured maximum candlepower values



KEEPING STEAM UP for War Production of Plastic Helmet Liners

Way back in the relatively calm days of '39, the Molded Products Company of Chicago were making radio cases for the pleasure of ordinary citizens. In May of that year they equipped one press with steam connectors of American Flexible Seamless Tubing. In September they equipped two more presses. In March 1940, under the pressure of war contracts, they equipped additional presses. And in July 1942, with the plant on 100 percent war production of helmet liners and plastic wheels for hand trucks, the remaining presses were given the added security of these steam-tight, free-moving, long-lived connectors.

The experience of the Molded Products Company is but one more instance of American Metal Hose going in on trial . . . *and coming out on top.* Wherever a practically indestructible, flexible, air-tight conveyor is required, for oil, gas, or water; for vacuum service or for protecting electric wiring, American Flexible Metal Hose and Tubing are providing reliability and economy.

44191

AMERICAN METAL HOSE BRANCH
OF THE AMERICAN BRASS COMPANY

Subsidiary of Anaconda Copper Mining Company

General Offices: Waterbury 88, Connecticut

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

ANACONDA

American Metal Hose

Why SCHRAMM COMPRESSORS are Water Cooled!

The basic system of any cooling system is simply to remove heat of piston travel and reciprocating parts from the surrounding metal as quickly as possible by the cooling medium. Heat travels from metal to water 200 times faster than from metal to air. By using water to carry heat away and by providing water jackets which completely surround compressor cylinders and heads, SCHRAMM achieves the following outstanding advantages:

...assured uniformity in cooling.

...elimination of unequal expansion and contraction which might cause distortion.

...absolute control of operating temperatures to the desired degree.

...longer life to compressor parts.

...higher efficiency of compressive cycle.

...higher compressor capacity at lower power cost.

...greater capacity in smaller overall space requirements.

...ability to provide compressed air efficiently under any and all temperature conditions.

...ability to provide compressed "air where it's needed," regardless of the amount of water available for cooling. SCHRAMM compressors are built in types equipped for re-cooling water (as well as for running water).

Get all the facts . . . **NOW!**

Write at once for complete details. Send for Catalog No. 42-S.

SCHRAMM, INC., WEST CHESTER, PA.

SCHRAMM Air Compressors

range from 7,500,000 for 12-in. to 32,000,000 for 24-in. searchlight. Three circular louvers prevent escape of stray light. *General Electric Co, Schenectady.*

Water Coolers

ELECTRIC WATER COOLERS have 5- 10- and 20-gal. cooling capacity per hr, based on Navy requirements of 100 F room temperature and 100 F entering water, cooled to 50 F. Coolers have entire operating mechanism supported by a frame independent of cabinet frame. Cabinet panels removable for

repainting, replacement, inspection or adjustment without interruption of cooler operation. Available for industrial use as soon as Government limitation orders permit, according to manufacturer. *Cordley & Hayes, 443 4th Ave, New York, N. Y.*

Vacuum Switches

FOR INDUSTRIAL and radio switching applications, four new vacuum switches are also adapted to oil- or water-immersed operation because of their inclosed construction. They are especially applicable to hazardous installations and where space is at a premium. Two of the switches are also designed for high altitudes. No self-contained coil or other operating mechanism. Movement is obtained from mechanism to be controlled or other apparatus. External fulcrum is eliminated by flexible diaphragm which transmits movement to contacts and acts as natural fulcrum point for operating arm. Contacts close without vibration, making it possible to

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

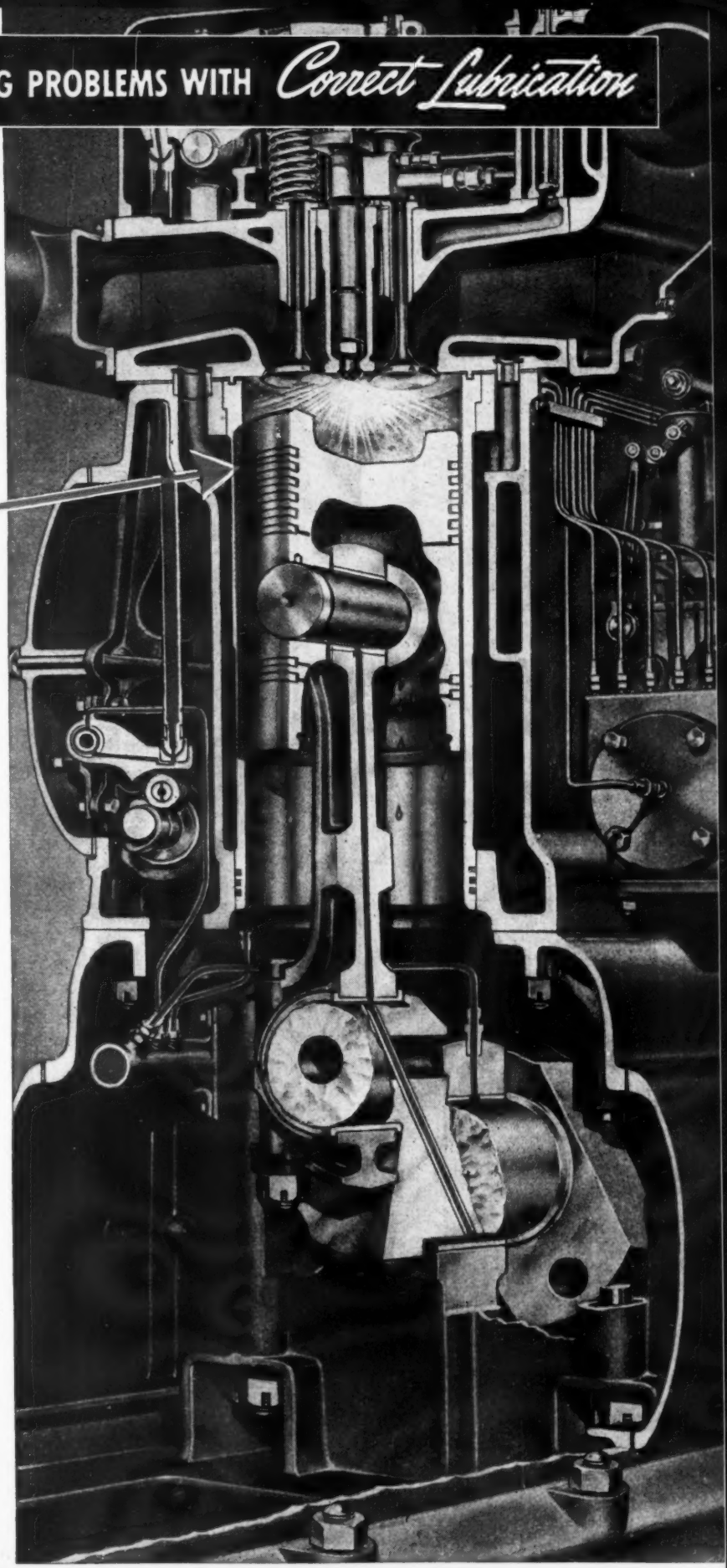
HOW TO SOLVE OPERATING PROBLEMS WITH *Correct Lubrication*

GET

Full Power

WITH

Free Rings!



IN DIESEL ENGINES like this, a vital lubrication problem is to keep rings, pistons, and valves free from hard carbon deposits.

This calls for special oils that will not only resist the formation of deposits but will make certain that any deposits which do form are soft and fluffy. These oils also must provide strong films (even when squeezed to microscopic thinness) to protect against wear.

Gargoyle D. T. E. Oils are specifically designed to meet these exacting requirements. They're made from specially selected crudes, and refined to stand up under the highest temperatures and pressures of Diesel operation.

•

Socony-Vacuum Oil Co., Inc.

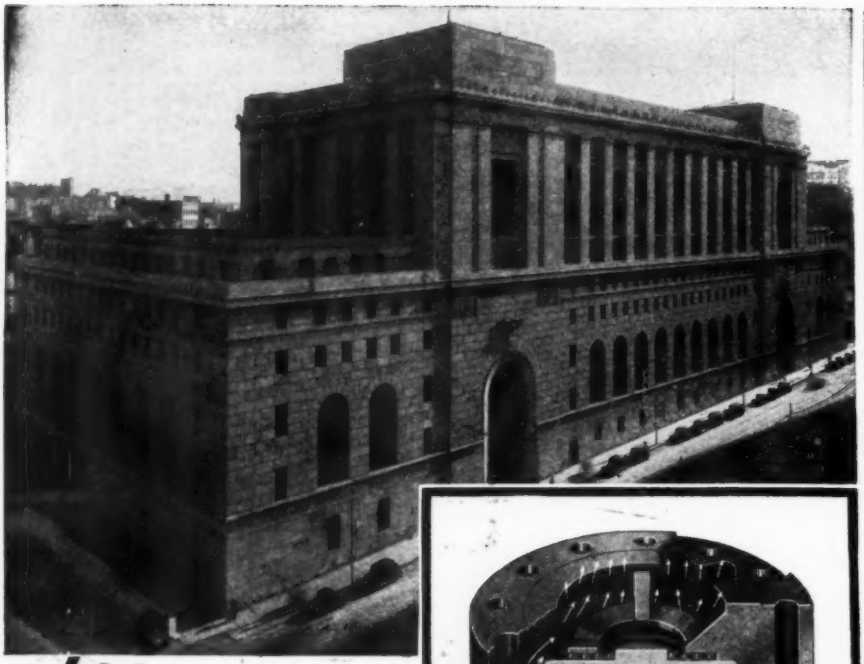
Standard Oil of N. Y. Div., White Star Div., Lubrite Div., Chicago Div., White Eagle Div., Wadhams Div., Magnolia Petroleum Co., General Petroleum Corporation of California.

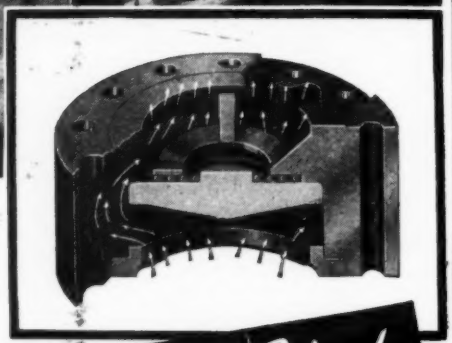
GARGOYLE

Lubricants

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

CALL IN SOCONY-VACUUM





WILLIAMS-HAGER

FLANGED *Silent* CHECK VALVES

Williams-Hager Installations Include:

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Tennessee Valley Authority, Fontana, N.C.

Statler Hotel, Washington, D.C.

Mellon Art Gallery, Washington, D.C.

Radio City, New York City

Kaiser Co., Inc., Fontana, Calif.

Standard Oil (Indiana) Whiting, Ind.

Tight under *every* condition of service and pressure—WILLIAMS-HAGER Flanged Silent Check Valves assure unrestricted and uninterrupted flow of liquids. No webs to hamper flow . . . operates in any position . . . and of simple, compact design.

Available in iron, semi-steel, bronze, cast steel, stainless steel or monel . . . 1″ to 20″ inclusive, pressure resistant to 6000 pounds.

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

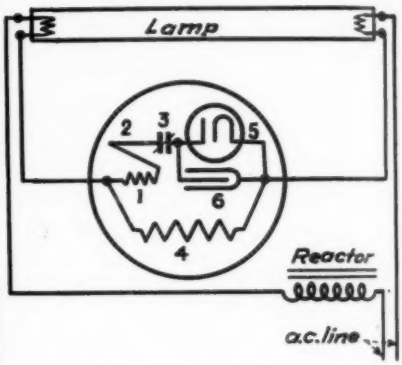
Write for this interesting brochure

2055 Pennsylvania Ave., Pittsburgh 12, Pa.

mount switches on or near delicate instruments. Vacuum construction gives switches a high current rating for their size, according to maker, and permits them to handle enough power to operate equipment at reduced voltages. *electronics dept, General Electric Co, Schenectady, N. Y.*

Lamp Starter

NO-BLINK FLUORESCENT lamp starter for 40- and 100-w lamps. Low resistance heater (1) carries starting current, and as glow switch attempts to start a deactivated lamp, gradually heats bimetal (2) and opens lockout contacts (3) in glow switch (5) circuit. Open-circuit voltage then exists across resistor (4) which draws a negligible current but produces sufficient heat to hold lockout



contacts (3) open. When failed lamp is replaced, starter automatically resets to its normal position. Condenser (6) eliminates radio interference. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Four-In-One Dynamotor

DYNAMOTOR PROVIDES four closely regulated voltages, +14½, −150, +300 and 150+300, or 450. Output voltages are held constant for all normal input-voltage variations. This is accomplished by a regulator field which weakens when input voltage rises and strengthens when voltage drops; the regulator utilizes a separate core. Complete armature has four commutators, two cores and four windings. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Plastic-Face Hammers And Mallets

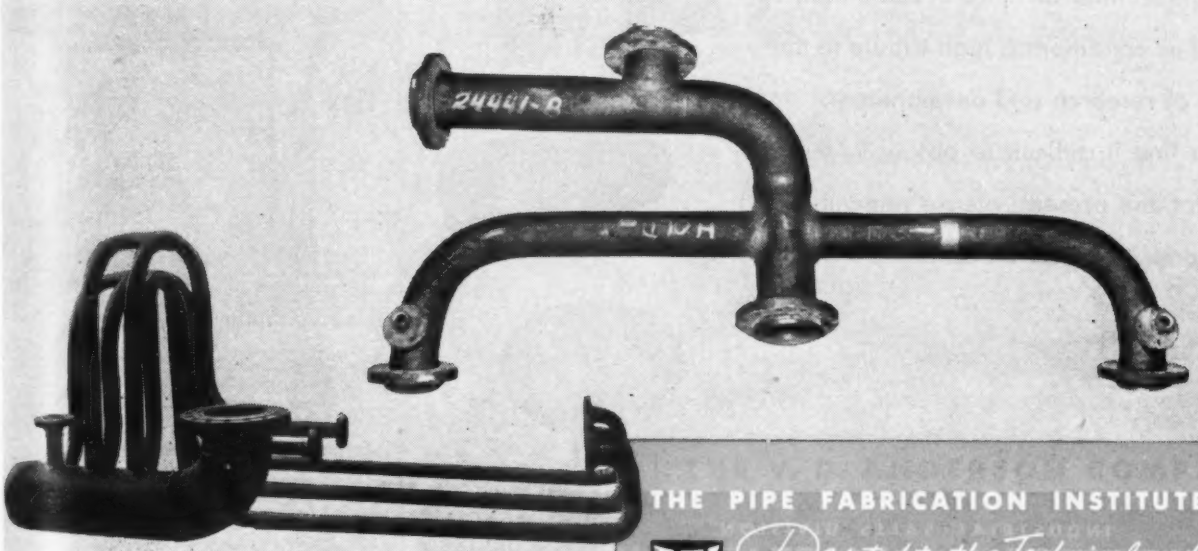
BASA PLASTIC-FACE HAMMERS and Empire plastic mallets recommended as substitute for rawhide-face hammers and mallets. Tough, resilient plastic will not chip, split or *mushroom*, nor mar struck surface, according to manufacturer. Hammers have Basa feature

FOR BETTER PRESSURE PIPING *Use* PRE-FABRICATED PIPING

Pre-fabricated piping is delivered to the job as a series of subassemblies with all difficult operations performed in the fabricating plant . . . thus facilitating easy, rapid and economical installation. These subassemblies are commercially practical, heat treated and stress relieved when necessary, correctly aligned, thoroughly cleaned, shop tested, and inspected.

Pre-fabricated piping is prepared in plants equipped with considerable special machinery and staffed by highly skilled organizations. Much of this specialized equipment is not readily available in the field. The qualified fabricator has an organization with long and varied experience in the practical possibilities and limitations of piping . . . can frequently contribute suggestions that simplify and improve piping layout, save time and reduce costs.

Pre-fabricated piping has many advantages for the user of pressure piping.

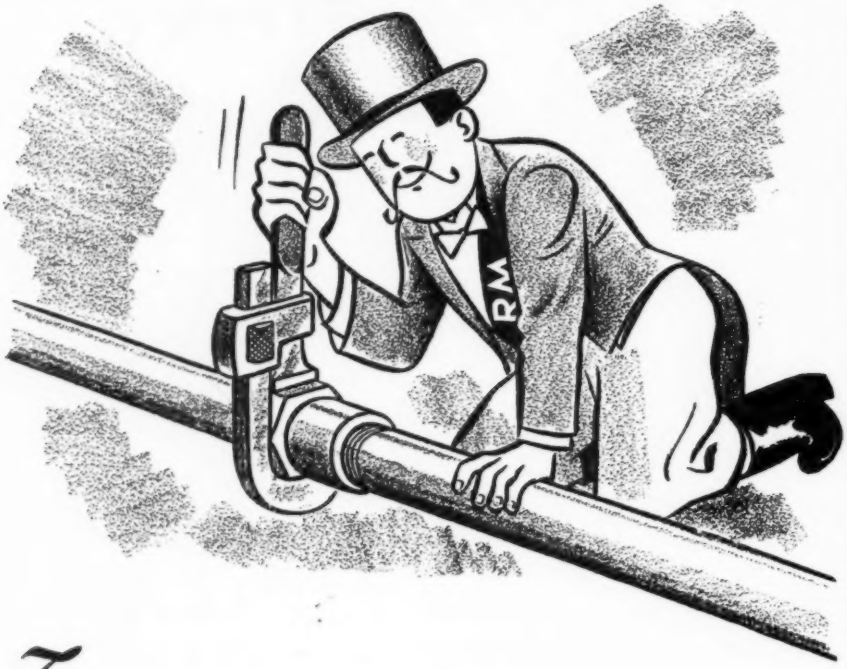


THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING PITTSBURGH, PA.

JOIN UP *with* R/M SHEET PACKINGS



The right connections are vital today —the kind that hold the line against the higher pressures of forced production. There are R/M packings for every type of piping problem, and their performance under all kinds of abnormal, war-time conditions is high tribute to the years of research and development.

If you find it difficult to obtain R/M packings for the present, please remember high priorities must be served.

ARMY E NAVY

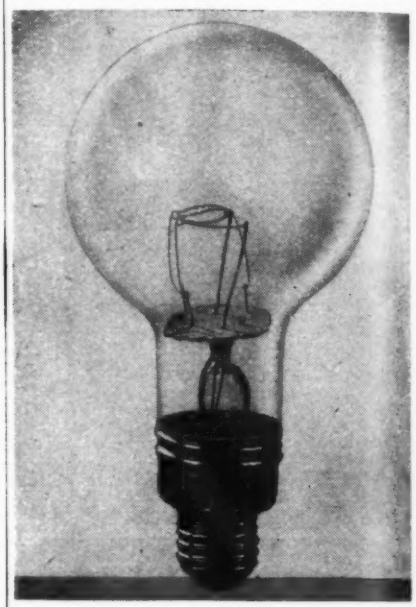
Awarded to R/M
North Charleston Plant

INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

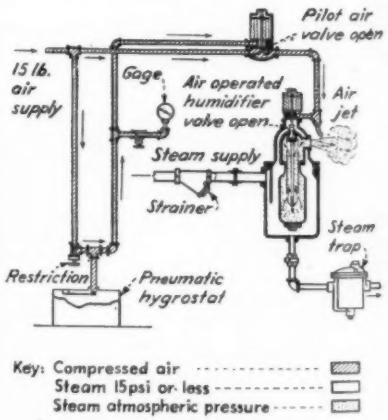
of adjustable head and speedy face replacement by movable jaws and locknut. *Greene, Tweed & Co, 4377 Bronx Blvd, New York 66, N. Y.*

Infra-Red Lamps

SUPERLOCK CONSTRUCTION uses no cement or strap for permanently locking base and bulb against continuous high temperatures of infra-red lamps for industrial baking, drying, preheating and



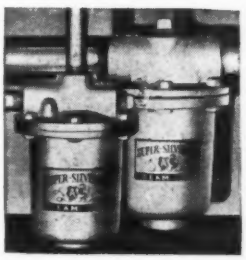
dehydrating. Base lining made with protrusions which fit into indentations in bulb neck and lock into position by crimping of metal base. Ceramic heat reflector disk replaces mica disk. *Birdseye div, Wabash Appliance Corp, 335 Carroll St, Brooklyn, N. Y.*



Compressed Air Humidifier

EXPLOSION-PROOF humidifier valuable in places where there are mixtures of air and gas, or air and dust, or where explosive materials are in process. Standard unit includes a pneumatic hygrostat, pilot valve and CK2 humidifier fitted with air-actuated steam valve, air outlet nozzle, steam strainer and drain-

Use this STEAM TRAP GUIDE
in making your postwar equipment plans



Every sign points to a vital need for more economical production in postwar times. In considering the installation of new steam using equipment, now or after the war, more economical production can be attained through the selection of the right steam trap for that equipment. The difference between a good steam trap, well chosen for the job, and a trap poorly selected, may mean the difference between profit and loss on that equipment.

In making recommendation for new steam using equipment and traps, use the book, "How to Choose a Steam Trap," as a guide. It contains a wealth of detailed information to show you how to select a steam trap that will give more economical production from steam using units. It also describes SUPER-SILVERTOP STEAM TRAPS, noted for their savings in fittings, time and work because they can be installed as an elbow or straight-in-line.

To help you with your postwar plans, we will gladly send you a free copy of the book, "How to Choose a Steam Trap" upon request.

THE V. D. ANDERSON COMPANY
1934 WEST 96th STREET • CLEVELAND 2, OHIO

Gentlemen: Please send me a copy of "How to Choose a Steam Trap." I understand this does not obligate me in any way.

Name .....

Company .....

Address .....

City ..... *State* .....

Tells

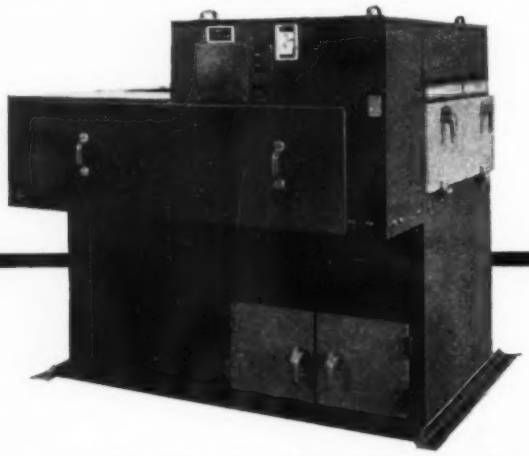
WHEN BOILERS *START* WASTING COAL

Until you catch them on a coal-burning binge, your boilers can waste tons of vital fuel. But, when you know the hourly or daily weights of coal consumed by each boiler, you can locate waste and correct its cause before fuel loss becomes serious. For this you need weight records — dependably provided by a

RICHARDSON AUTOMATIC COAL SCALE

Gives accurate fuel consumption figures that help you to keep every boiler at highest possible efficiency and cleanliness always. In addition, the Richardson Scale is dustproof, increases live storage in continuous bunkers while using minimum headroom. Needs no attendant for economical day and night operation.

Richardson supplies complete installations from bunker to stoker, including inlet gates, scales for any purpose, magnetic head pulleys, "no-flow" alarms, and distributors to stokers. Whatever the nature of your plant, public utility, manufacturing plant, or institution, a Richardson coal scale will furnish records for saving coal and its transportation. Bulletin 1143—containing 45 pages of details, installation photographs and diagrams—is yours on request.



RICHARDSON

RICHARDSON SCALE COMPANY, CLIFTON, N. J.

Atlanta Boston Chicago Minneapolis Montreal New York
Omaha Philadelphia San Francisco Pittsburgh Toronto Wichita

5542

age trap. Diagram describes humidifier operation when air-relief valve in pneumatic hygrostat is open. *Armstrong Machine Works, Three Rivers, Mich.*

Goggle-Cleaning Cabinet

MSA GOGGLE-CLEANING CABINET is equipped with Fogpruf (lens-cleaning and anti-fogging agent) and optical wiping tissues. Unit is ideal for mounting in strategic work locations and in

repair rooms, tool rooms, locker rooms or on traveling goggle-dispensing carts. *Mine Safety Appliances Co, Braddock, Thomas and Meade St, Pittsburgh, Pa.*

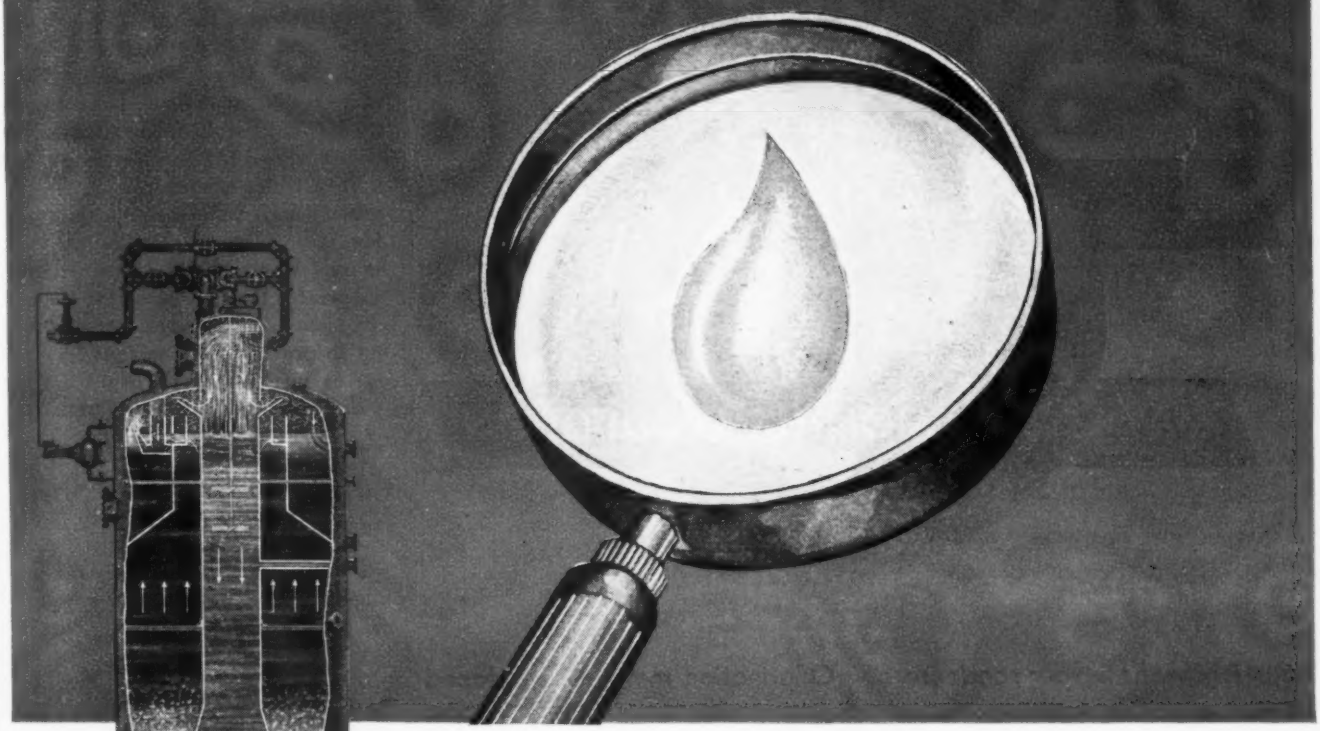
Baking Varnish

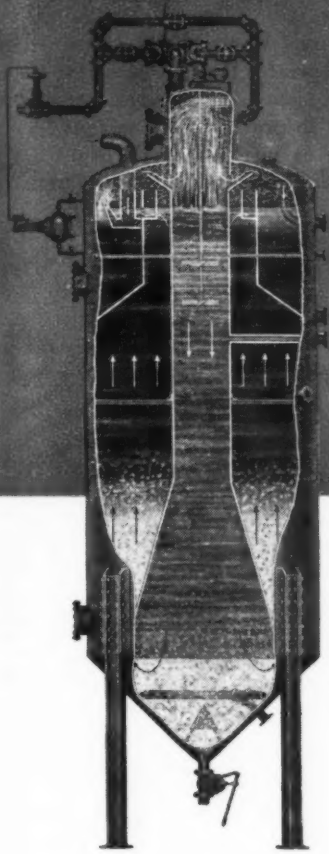
ELECTRICAL INSULATING PG-4 clear-baking varnish, for high-speed armatures and tightly wound fine-wire coils, bakes out in 4 to 8 hr at temperature from 250 to 275 F. Exact baking time depends upon size and construction of unit and whether hard or flexible insulation is desired. May be baked out by infra-red-ray equipment or oven. *John C Dolph Co, dept 41, 168 Emmett St, Newark, N. J.*

Quick Calculator

SLIDE RULE is said to permit quick and accurate determination of inductance, capacitance and frequency components of series or parallel-tuned RF circuits, as well as inductance, turns per in., wire type and size, coil diameter and length for single layer-wound solenoid RF coils. Calculator sold with instruction sheet. *Allied Radio Corp, 833 W Jackson Blvd, Chicago 7, Ill.*

H_2O . . . and what else?





Cross-section view of a Graver Hot Process Water Softener with Deaerating Equipment.

RAW WATER is seldom fit for boiler feed use. And it's the extra ingredients that cause the trouble . . . calcium and magnesium bicarbonates, for instance. When heated, these compounds become insoluble . . . form scale on the boiler tubes . . . reduce heat transfer efficiency . . . and even cause localized overheating.

Graver Hot Process Water Softeners effectively remove these impurities in the raw water supply . . . improve boiler efficiency . . . eliminate frequent shutdowns for tube cleaning . . . and materially reduce the cost of maintenance and repair. It's a job they're doing in hundreds of plants all over the country . . . efficiently and economically.

Whatever your water conditioning problem may be, you'll find 't worthwhile to consult with a Graver engineer. He'll submit unbiased recommendations and estimates without obligation.

Water Conditioning Division of

GRAVER TANK & MFG. CO., INC.

4809-25 Tod Ave., East Chicago, Ind.

NEW YORK CATASAUQUA, PA. CHICAGO TULSA

GRAVER

WATER CONDITIONING EQUIPMENT

Hot Process Water Softeners • Zeolite Water Softeners • Water Filters
Oil Removal Filters • Taste and Odor Removal Filters • Chemical Proportioning Equipment • Filtering Material • Reactivators

TWO WEEKS

Slime growths in your condensers often speed up suddenly as climatic change affects cooling water. Vacuum is lost just when you need full capacity output.

Even if slime formation is serious but two weeks out of a year, the lack of power can throw wartime plant schedules badly out of line. A shutdown for cleaning may be out of the question.

Treatment of condenser cooling water by Wallace & Tiernan Chlorination methods developed specifically for such conditions protects you from any such emergency. Condenser tubes *stay* clean. Equipment operates at top efficiency.

To maintain your vacuum at or above manufacturers guarantee; to prevent the necessity of shutdown for cleaning; to save fuel costs; to save the labor of cleaning tubes, get the recommendations of Wallace & Tiernan Engineers.

CD-4

WALLACE & TIERNAN

PRODUCTS · INC.

Manufacturers of Chlorine and Ammonia Control Apparatus

Belleville 9, New Jersey • Represented in Principal Cities

Argument Corner

(*Continued from page* 124)

coal per day instead of 5 tons. If it takes 100 tons to handle the load at 70% efficiency, then at 75% efficiency only 70/75 of 100 tons is required, or 93.33 tons. Conversely, at 75% efficiency the 100 tons of coal per day would handle 75/70 of the load carried at 70% efficiency, or 107.1% of the load carried at 70% boiler efficiency.

Incidentally, that 6.67 tons saved per day is 33% more than Mr Stilwell's figures show as being saved. However, the point is that we must save coal actually—not just through calculations—but in proving these savings let's keep our calculations on the right basis.

Erie, Pa. W W PETTIBONE

Comments on Data Sheet Number 134

Here is a letter prompted by the belief that certain misinformation appears in the fire-extinguisher chart (POWER, *Oct, page 134) which we reprinted from "Handbook of Fire Safety Practices," Ebasco Services, Inc. In answer to the discussion below, the author of the handbook has this to say: "The Ebasco handbook data constitute recommendations for a particular group of utility companies, based on accumulated experience and judgment, and do not necessarily coincide with information issued by other interests concerned with fire protection in general."—Editor*

ON THE DATA SHEET "Portable-Fire-Extinguisher Types," the designations following "Underwriters' Classification" appear correctly for each type of unit, but a number of the statements following the lines "Effect produced" and "Effect on fires" are at variance with those classifications, as follows:

The loaded-stream extinguisher carries "A" and "B" classifications, meaning that the unit is suitable for use on both ordinary combustibles (Class A fires) and flammable liquids (Class B fires). But under "Effect on fires," the chart reads, "Fair." for "flammable liquids." It should read "Good" or "Excellent."

The Foam extinguisher also carries "A" and "B" classifications. Quoting the National Board of Fire Underwriters, the "A" means "fires where the quenching and cooling effect of quantities of water or solutions containing large percentages of water is of first importance." Following "Effect pro-

WHERE DO THEY USE ALL THESE MOTOREDUCERS WE MAKE?

WELL, YOU CAN FIND THEM DRIVING ALL KINDS OF MACHINERY IN ALMOST EVERY TYPE OF INDUSTRY

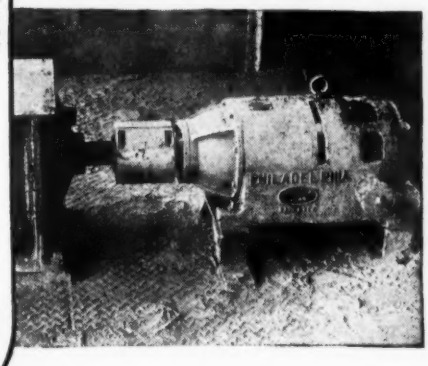
That statement covers a lot of territory, but so do Philadelphia MotoReduceRs. That's because MotoReduceRs are made in both horizontal and vertical types, in a wide range of horsepowers and ratios, and with any available type of motor. So, it's logical that for driving all kinds of equipment where a self-contained unit is indicated, the Philadelphia MotoReduceR provides an efficient, economical and trouble-free solution. Our Catalog M R 40 gives mechanical details and shows typical installations-why not send for a copy today?

★ **A.G.M.A. STANDARD OUTPUT SPEEDS**

STANDARD OUTPUT SPEEDS for concentric and parallel shaft integral hp Gearmotors. Based on 1750, 1430 or 1165 rpm motor operating speeds.

1430	190	25
1170	155	20
950	125	16.5
780	100	13.5
640	84	11.0
530	68	9.0
430	56	7.5
350	45	6.0
280	37	5.0
230	30	4.0

AGMA



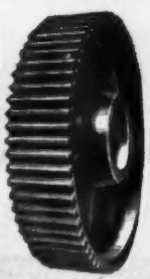
ARMY NAVY

PHILADELPHIA GEAR WORKS, INC.

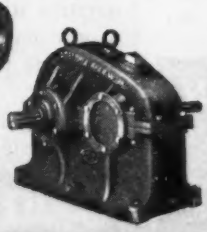
INDUSTRIAL GEARS AND SPEED REDUCERS LIMITORQUE VALVE CONTROLS

ERIE AVENUE & G STREET
PHILADELPHIA 34, PENNA.
NEW YORK, PITTSBURGH, CHICAGO

Philadelphia LIMITORQUE CONTROL operates all types of valves, etc., safely, economically, from convenient stations.



Philadelphia GEARS All types and sizes of industrial gears. Can be supplied in all materials.



Philadelphia HERRINGBONE SPEED REDUCER for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

Philadelphia MOTOREDUCER The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.

Philadelphia WORM GEAR SPEED REDUCER right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

DURAMETALLIC Packings

KEEP 'EM PUMPING! Our war effort requires that every pump be kept working to capacity. That's why it's important to specify DURAMETALLIC PACKINGS for longer runs, better sealing and minimum wear.

★

Write for Illustrated Bulletin and Free Engineering Counsel.

★

The DURAMETALLIC "Twist"

- Processed to retain lubrication.
- Provides readier response to gland pressure.
- Distributes frictional load over several diagonally wrapped metallic sheets.

The PERFECT SEAL

DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

HOUSTON • LOS ANGELES • CHICAGO • NEWARK • NEW ORLEANS
SAN FRANCISCO • SEATTLE • TULSA • MONTREAL • YOUNGSTOWN, O.
DETROIT • FREDERICKSBURG, VA. • KANSAS CITY • DALLAS

duced," the chart reads "Blanketing." It should read, "Cooling, blanketing."

The Carbon Tetrachloride types (incidentally, the one-gallon unit shown is a "Stored Pressure" type, not "Stored Press") carry "B" and "C" classifications, just as do the Carbon Dioxide and Dry Compound types—meaning they are suitable for use on flammable liquid (Class B) and electrical (Class C) fires. Under "Effect on fires," the chart reads, "Fair," for "flammable liquids," and "Good," for "electrical" and "vehicles." The "effectiveness" of a one-quart unit, because of the small quantity of fluid contained in that size, might be described as in the chart, though the "effect" is not determined by quantity. But the descriptions are certainly inaccurate for the one-gallon unit. The chart should read "Excellent" for all three classes of fire, just as it does for Carbon Dioxide and Dry Compound.

As to effect on Class A fires, under the Carbon Tetrachloride extinguishers, the chart reads, "Poor," whereas under Carbon Dioxide and Dry Compound, it reads, "Fair." The regulations of the National Board of Fire Underwriters say, for all three types:

"They are not effective on deep-seated fires of ordinary combustible materials . . . but they may be of value for surface fires in small quantities of such material where the smothering effects of the gas may be utilized."

Whether the word to describe their effect should be, "Poor," or "Fair," is a question of point of view, perhaps, but should be the same for all three.

Under Carbon Dioxide, the chart reads, following "Effect produced," "Smothering, cooling." It should read, "Smothering," as the cooling effect of the gas in hand extinguishers is negligible. The extinguishing action is due to cutting off the oxygen supply.

New York, N. Y.

L W HUTCHINS, DIRECTOR
Safety Research Institute, Inc

Old Pumps for New Jobs

IN THE NOVEMBER ARTICLE, "How to Tailor Centrifugal Pumps to Fit New Applications," the author is commendable in his intent to familiarize operators with pump reapplications. But I question whether an article so short as to give only part of the story is not a disservice to both operator and manufacturer.

Passing over for the moment one obvious error and some less important points, there are two unfortunate omissions: (1) No precautions in pump reapplication are suggested; in fact, are

Coverage for the life of your turbine

Why you avoid troublesome deposits . . . never need clean your turbine*. . . when you use Nonpareil

Turbine oil deposits (except those caused by operating under dusty or other outside contaminating conditions) stem from two types of unstable hydrocarbons. One of these tends to form asphaltenes. This type can be entirely removed by refining, but only with the certainty of also removing valuable natural inhibitors. Such removal makes the oil more likely to develop acids than it was originally. (And acids form sludge.)

Common practice, therefore, is to remove as large a percentage of the asphaltene-formers as the refiner dares. The balance, left in the oil, is like a bad apple in a barrel. It contaminates the oil and causes deposits, which are part of the familiar and troublesome sludge.

The other problem—acid-formation—can't be prevented by any refining practice we know about. This, too, contaminates conventional oil. Thus the problem is to remove all the asphaltene-formers without harming the oil, and to prevent the formation of acids.

How Nonpareil solves the problem. In refining Nonpareil Turbine Oil, we remove every trace of asphaltene-formers—even though, by so doing, we also take out natural inhibitors. We can do this, because we add synthetic inhibitors that actually do a better job than the natural ones.

That is the basis for our patent on Nonpareil. It is the advantage, exclusive with Nonpareil, that lets us give a written guarantee that the acidity will not exceed the extremely low limit of 0.15 mgKOH/gm for the life of your turbine!

The effectiveness of this method of manufacture is demonstrated by service records on turbines in which Nonpareil is still operating after 16 years without sweetening, batch treatment, or replacing, and with no sign of troublesome deposits.

Corrosion control another feature. A corrosion inhibitor has been used in Nonpareil Turbine Oil since 1926. But a continuous study of this problem has been carried on. Hundreds of materials have been examined and thousands of tests made. An improved corrosion inhibitor is now used in Nonpareil which meets all requirements of corrosion protection without impairing other desirable qualities.

Recently the American Society for Testing Materials developed test D665-42T for determining the ability of turbine oil to aid in preventing the rusting of ferrous parts in the presence of water. Nonpareil Turbine Oil passes this test with perfect results.

Get all the facts. A Standard Lubrication Engineer will be glad to supply full test data and service records on Nonpareil. Call any Standard Oil Company (Indiana) office, or write 910 S. Michigan Avenue, Chicago 5, Illinois. In Nebraska, address Standard Oil Company of Nebraska at Omaha 2.

Oil is Ammunition . . . Use it Wisely

NONPAREIL TURBINE OIL

*Except when replacing other turbine oil with a fill of Nonpareil

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

Lubrication *News* letter

Practical suggestions from the field on how Lubrication Engineering and lubricants are being used by midwest operators to lick tough wartime jobs. **FEBRUARY, 1944**

Compressor fire hazard reduced. Excess oil in the receiver of multi-stage compressors is never desirable—it can be dangerous. When heavy loads, long hours of operation, or faulty cooling units allow operating temperatures to rise it presents a definite fire hazard.

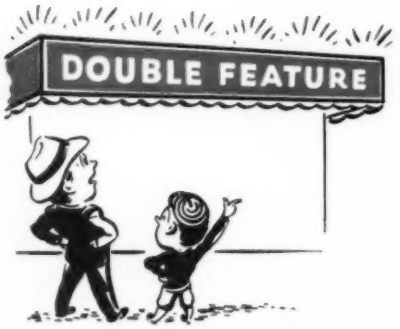
A Michigan war plant found it out the hard way—by experience. After one or two "experiences" which left no doubt that something had to be done, a Standard Lubrication Engineer was called in. He made three suggestions:
1. Lower intake air temperatures.
2. Lower cooling water temperatures in the after-coolers. This not only cools the air, but also condenses oil vapor before it is carried over into the receiver.
3. Lastly, but of first importance, use a better oil so that less is needed to secure adequate lubrication.

In this case Stanoil 31 was the answer. After three months' use there has been no recurrence of receiver fires, and oil consumption has been reduced 50% with adequate lubrication of the compressors.

P. S. to the above. As an added attraction, Stanoil and the Lubrication Engineer also cured a long standing problem on this Michigan plant compressor. Windings on the compressor motor were oil soaked. The Engineer pointed out that Stanoil's high V. I. (viscosity index)—a quality which prevents it from thinning out excessively when temperatures go up—would keep the oil *in* the motor bearings and *off* the windings. It did just that. The saving in maintenance this made was almost as important as the 50% saving in oil consumption mentioned above.

Two reasons why some Hydraulic Oils go bad—and Stanoil doesn't

Viscosity increase and acidity are two signs of deterioration in hydraulic oils. Either may make hydraulic oils unfit for further use.



An excessive increase in viscosity makes operation sluggish in most hydraulic systems. High oil acidity causes deposits, oil discoloration, and poor separation from water which may result in foaming and erratic operation if there is moisture in the system.

Stanoil is made to reduce both of these troublesome causes of hydraulic oil failure, not just in laboratory tests but in actual service. For example, a Lansing, Michigan plant uses a large quantity of hydraulic oil. Because of this an accurate check is maintained on oil condition. Records from this plant show a typical sample of Stanoil No. 18 after 2392 hours of almost continuous operation to have the same viscosity as unused oil, and a neutralization number of only 0.15. Stanoil has operated in this plant for periods as long as 7200 hours with no appreciable change in viscosity or acidity, and it has not been necessary to change oil in some units in over a year.

If you are obliged to change hydraulic oil frequently or have deposit trouble, erratic operation, or persistent foaming, let a Standard Lubrication Engineer analyze your problem. A change in the hydraulic system or a change to Stanoil, or both, may save labor, down time, and oil.

What are YOUR problems in maintenance and lubrication?

The few examples cited here are typical of jobs Standard Lubrication Engineers are doing daily for operators who have asked for help. Take the time to explain your problems to one of these Engineers. He may have a number of suggestions that will help you save much needed manpower, material, and scarce equipment. Call any Standard Oil Company (Indiana) office, or write 910 S. Michigan Avenue, Chicago 5, Illinois, for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Can't throw Stanodrip. Lubrication of stitching machines making wire bound boxes is a tough job. Action of many parts on the machine is very rapid and jerky. Ordinary lubricants tend to fly off in all directions. Oil on the box wood spoils the work. Oil on operators means less oil stays in the machines.

Machine operators were the first to cheer for Stanodrip when it was tested. They got less spoilage, less trouble from machines because of too little lubricant, and spent less time putting oil on the machine and taking it off of themselves. Stanodrip is on this job to stick.

Oil is Ammunition . . . Use it Wisely

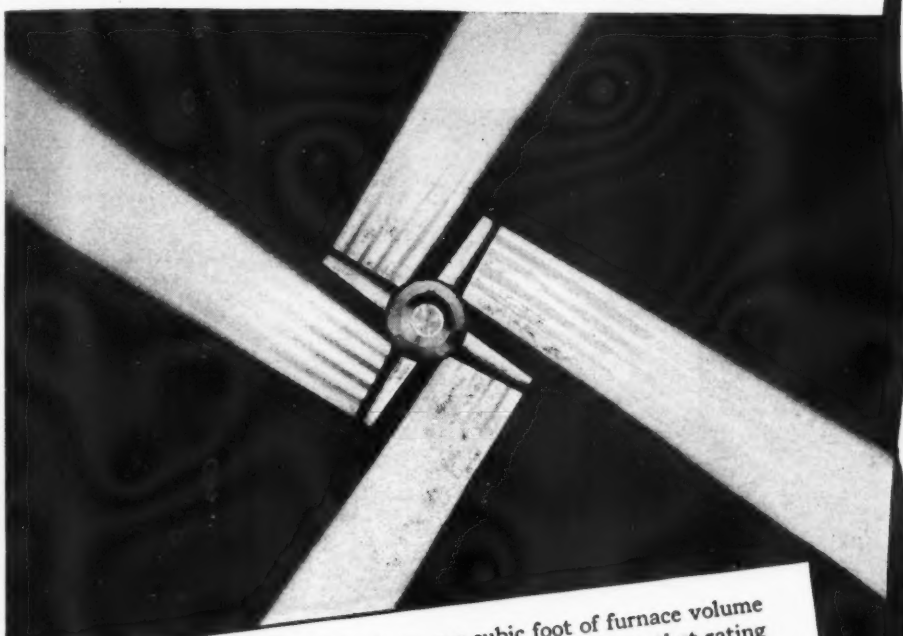
STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

HOW TO INCREASE THRU-PUT BY ONE SIMPLE CHANGE

Pinwheel Action STEPS UP RATINGS

Installing Coppus-Dennis FANMIX Gas Burners permits increased heat release per cubic foot of furnace volume

"Pinwheel Action" combines gas with air in a properly proportioned mixture. Gas escaping from orifices in the blades, rotates the fan, causing in-take of air at right angles to path of gas. The energy in gas under pressure is utilized to perform work by mechanically mixing and proportioning the gas with just the proper amount of air, thus eliminating from the furnace the necessity of serving as a mixing chamber as well as combustion space.



You get so much more heat release per cubic foot of furnace volume when you change to Coppus-Dennis FANMIX Gas Burner that rating of boilers (or other equipment) can be increased far beyond the limit allowed by present burners.

New Principle in Gas Burners Gives EXTRA Values on Top of GREATER HEAT RELEASE

Even Temperature: complete combustion without impingement—no drifting "hot spots". *No Cracking of Wet Gas:* driver arms stay below "cracking" temperature. *On New Installations:* smaller combustion space, less stack required, no forced draft equipment needed. Write for free Booklet 410-3 which explains *other* savings you make with Coppus-Dennis FANMIX Gas Burner — a Coppus "Blue Ribbon" Product. Address: Coppus Engineering Corporation, 512 Park Avenue, Worcester, Massachusetts.

You'll get valuable ideas from these free bulletins on other Coppus Blue Ribbon Products

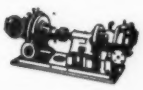
(Check the ones you want)

☐ Coppus Unit Air Filters. For industrial ventilating and air conditioning systems. Bulletin F-320-5.

☐ Coppus Heat Killers. Keep production up by keeping men cool. No stale air recirculation. Air is directed. Bulletin 160-5.

☐ Coppus Cable Manhole and Tank Ventilators. For confined working spaces. Bulletin 163-1.

☐ Coppus Boiler Manhole Blowers and Exhausters. For cooling boilers, drums, etc. Bulletin 161-3.



☐ Coppus Steam Turbines. 6 sizes (and prices) from 150 H. P. down to fractional. Bulletin 135-9.

☐ Coppus-Dennis Fanmix Gas Burner (described in this ad).

Name.....

Company.....

Address.....

City.....State.....

COPPUS

Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in REFINERY CATALOG.

COPPUS BLUE RIBBON PRODUCTS DESIGNED FOR YOUR INDUSTRY . . . ENGINEERED FOR YOU

For V-DAY BUILDING

BENEFIT BY CONNERY V-STIFFENED NON-BUCKLING LEAKPROOF BREECHINGS . . . .

We take pardonable pride in the fact that 100% of Connery output is going to war production projects. And we feel certain that the many plants using (and planning to use) Connery's Improved Expansion Stiffened Construction for stacks, breechings, ducts, etc., won't mind if we give our best to "our first customer," Uncle Sam.

As government priority construction slackens, however, we will be in a position to offer old and new customers specific help on their problems of power plant construction.

STACKS • BREECHINGS • UPTAKES • HOPPERS • AIR DUCTS

RECENT INSTALLATIONS

NEW HAMPSHIRE GAS & ELECTRIC CO.	PORTSMOUTH, N.H.
UNITED ILLUMINATING CO.	BRIDGEPORT, CONN.
ROCHESTER GAS AND ELECTRIC CO.	ROCHESTER, N. Y.
INDIANAPOLIS POWER & LIGHT CO.	INDIANAPOLIS, IND.
CONSOLIDATED GAS ELEC. & LIGHT PR. CO.	BALTIMORE, MD.
VIRGINIA PUBLIC SERVICE CO.	ALEXANDRIA, VA.
U. S. NAVAL TRAINING STATION	GREAT LAKES, ILL.
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CONNERY
EXPANSION STIFFENED
CONSTRUCTION

only feebly implied in the last sentence. (2) No mention is made of pump suction requirements because of changes in pump speed or operating head.

Choosing an operating point for the pump is a precaution that must be considered in pump reapplication, and it applies in Fig. 1, Nov. It is not advisable to operate a centrifugal pump at the top of the *hump* of its characteristic curve, but the article implies with no restrictions that such operation is satisfactory. At this point, some pumps operate satisfactorily when they discharge into a system having sufficient friction resistance, but operation would be unsatisfactory when pumping into a system composed almost entirely of static (pressure) head. The pump is much too large for the conditions assumed and should be used only when another pump cannot be obtained.

There are no precautions concerning the effects on performance of the fluid pumped, and it is not clear that the example applies only to cold water, so that specific gravity, viscosity or temperature corrections need not be included.

Suction Submergence

Omission of effects of suction submergence on pump performance is unfortunate, yet the photo in the article appears to be that of a 3-impeller, 2-stage hotwell pump on which submergence is an important factor. No limit is given as to how much impeller diameter can be reduced before its performance falls off because of interaction between inlet and discharge. A pump operating satisfactorily could fail badly with the same suction conditions if its impeller diameter were reduced excessively.

It is well known that the lift or head, under which a pump operates, changes rapidly with the capacity delivered. This point has been ignored, yet improper suction conditions, for a capacity and head combination for which the pump was not designed, cause many troubles. This limitation is not apparent from the *discharge* characteristics alone in Fig. 1, 2 and 3.

On page 67, laws governing change in capacity, head and power for a change in diameter at constant speed are correctly stated, but the laws are approximate only and not *rigid*. Yet the example implies that the relation between the heads produced for two different diameters applies for constant capacity. With constant speed, if head at a given capacity is corrected in proportion to the square of the diameter ratio, a simultaneous correction for the capacity corresponding to the first power of this ratio is necessary. While

Standard Motor Control

FOR POSTWAR RECONVERSION

Westinghouse All-Purpose A-C Controls

Postwar reconversion will bring important control problems—you'll need all-purpose controls—and you'll need them quick.

Westinghouse is ready NOW to help you solve these problems—with a complete family of A-C Controls, a few of which are pictured here. They offer the maximum in flexibility of application and ease of installation.

Start now to anticipate your postwar control needs. For your assistance, Westinghouse has compiled a complete new volume of Control Buying Data (Catalog 7000). Get your copy today from the nearest Westinghouse district office (distribution will be made from district offices only—no mailings from Westinghouse headquarters). Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penna.

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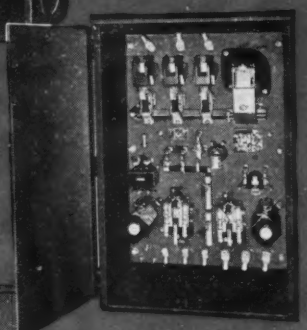
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Motor Control

Across-the-line A-C Magnetic Starter for Squirrel-cage Motors.



Reversing and Non-reversing Magnetic Starter.

Autotransformer Type Magnetic Reduced Voltage Starter.

Starting and speed regulating Rheostat.

Manual Motor-starting Snap Switch.

Reversing Drum Switches for Across-the-line Starting.

Type H Sentinel Breaker for Fractional Hp Motor Starting.

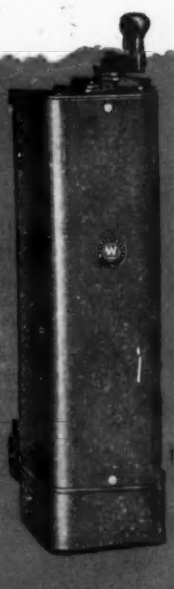
Manual Multi-speed Drum Controllers.

"De-ion" Motor Watchman Reversing and Two-speed Manual Starters.

Manual Multi-speed Drum Controllers.

Reversing Drum Controller for use with Primary Resistance.

Across-the-line "De-ion" Manual Motor Starter.



AT PAN AMERICAN AIRWAYS . . .

where insulation MUST NOT FAIL!

. . . THEY USE "MEGGER" TESTING INSTRUMENTS

Conditions of extreme heat, cold, moisture, vibration and corona are but some of the hazards to electrical insulation that are inherent in aircraft services. By carefully checking ignition harness, circuits and electrical equipment at frequent intervals with "Megger" Insulation Testers, aircraft maintenance men insure against electrical failures in flight.

Years ago, Pan American World Airways selected "Megger" instruments for this vital work and now, at Pan American bases throughout the world, the "Megger" tester is literally "first and last" in the ground crew's maintenance procedure.

Likewise, industry is today guarding its electrical equipment more than ever before and "Megger" Insulation Testers provide the means for this protection. Write today for a copy of our *Pocket Manual of "Megger" Practice No. 1420-P*—which presents the why and how of "Megger" testing.

THE NEW . . . U. S.-MADE "MEGGER" INSULATION TESTER

in plastic molded case; with the heritage of ruggedness and accuracy common to all instruments bearing the trade mark name "Megger" . . . *Write for new descriptive Bulletin 1735-P.*

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

this difference is small for pumps with very flat characteristics, it becomes appreciable for pumps with characteristics similar to those shown. For example, if at 300 gpm the 14.25-in. impeller develops 198-ft head, then the 12.9-in. impeller develops

$H = 198 \times 12.9^2 \div 4.25^2 = 162$ ft

$Q = 300 \times 12.9 \div 14.25 = 271$ gpm

The pump which delivers 300 gpm at 198-ft head delivers 271 gpm at 162-ft head when the impeller is cut from 14.25 to 12.9 in. diameter. This calculation is not strictly correct, but is sufficiently close as long as the reduction in impeller diameter is not large.

Criticisms concerning application of the law for computing the performance at constant speed from one diameter to another applies also to the formula for computing the effect of a change in speed.

The final sentence should be strengthened so that any operator who wishes to put an existing pump into a new service will check with the manufacturer before making changes in the pump.

Harrison, N. J. R M WATSON
Chief Engineer, Centrifugal Div
Worthington Pump & Machinery Corp

The Old Chief

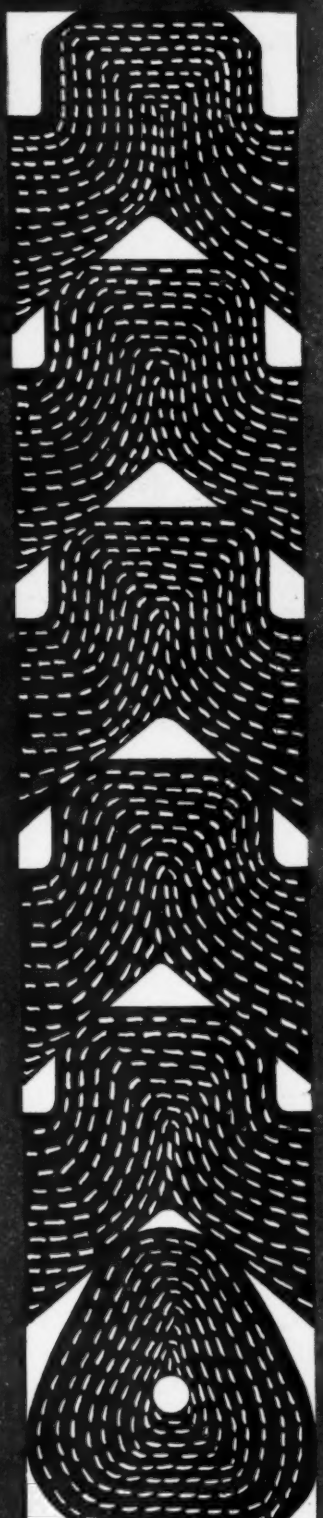
(*Continued from page* 99)

in fact, there was grease everywhere but where it should have been; that is, on the machined parts of the engines, which were deeply pitted with rust. At one end of the room stood the switchboard of paneled slate. Something had fallen against it; it was out of plumb and broken; the fittings were a mess of verdigris and littered with plaster from a break in the ceiling overhead. I knew the man who built that switchboard. David was his name, a man of curious and perfect craftsmanship.

I stood in the same spot the night he closed the first breaker on it. All the leading men and their families were there. I recalled that biscuits and coffee were served by Mrs Bumner; it was a merry occasion. I sighed and bared my head in that cold, dank place in memory of David. Perhaps it was well that he had not lived to see his handiwork in its present condition.

Down in the boiler room the gloom was even deeper; the rusty boiler fronts reared up into the mist above. From a broken window a thin shaft of light played on something that gave us a start. It turned out to be a tattered suit

AMFLEX SELF-ACTING PACKING IMPOSES MINIMUM FRICTION



BECAUSE IT SEALS WITH *Finger Pressure* AND PROVIDES THOROUGH LUBRICATION

AMFLEX is a sturdy self-acting lip packing designed especially for use on hydraulic rods and plungers against high or low pressures. The illustration shows the unique design of these rings which results in a perfect seal with the minimum of pressure against the moving rod or plunger. This construction permits application of packing with no more than finger-pressure against the moving parts, thus imposing a minimum of friction and resulting in decreased power consumption and longer packing life. AMFLEX packing sets are supplied in two different constructions—for cold water or cold oil uses, up to 210° F., and for hot water, steam or hot oil uses, up to 450° F. *When ordering, be sure to specify service intended.*

AMFLEX packing sets or rings can be furnished for rod diameters ranging from ¾ inch up, where the packing space between the rod and the stuffing box is not less than ⅜ inch.

Write for detailed bulletin showing typical installations and chart suggesting stuffing box details.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA 8, PA.

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Los Angeles 21, California	720 Mateo Street
Montreal, Canada	5575 Cote Saint Paul Road
Milwaukee 2, Wisconsin	4417 West North Avenue
New Orleans 4, Louisiana	418 Common Street
New York 13, New York	100 Sixth Avenue, near Canal
Philadelphia 8, Pennsylvania	401 North Broad Street
Pittsburgh 22, Pennsylvania	405 Penn Avenue
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San Francisco 7, California	156 South Park
Seattle 4, Washington	2207 First Avenue, South
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ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and

. . . you'll use it always

THE ALLPAX CO., INC.

Mamaroneck, N. Y.

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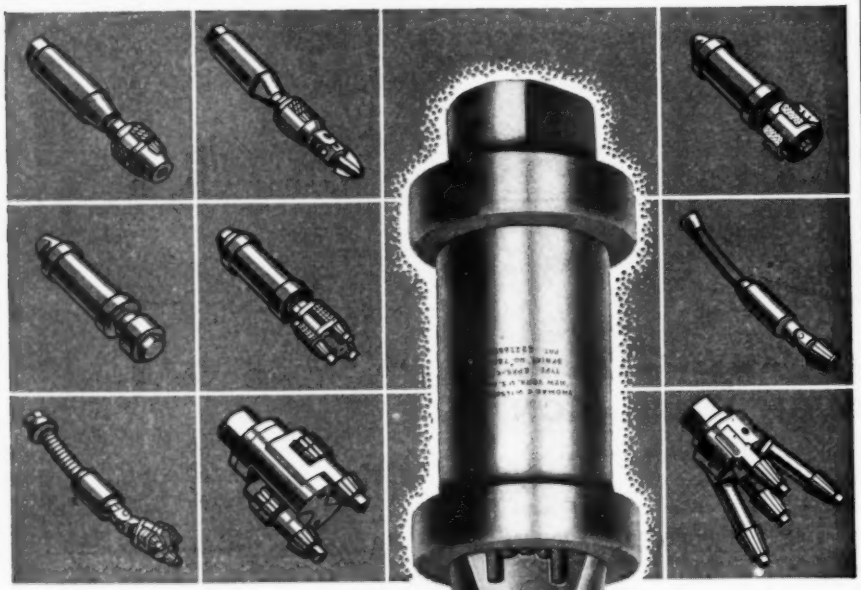
Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.



WILSON TUBE CLEANERS

EP (Extra Power) Air or Steam Motor With HSC Cutter Head.

With a wide variety of cutter heads, vibrating heads, vibrators, drill heads and brushes . . . for every conceivable kind of tube- or pipe-deposit.

Modern tube-cleaners for the problems of today.

wilson

PIPE AND TUBE CLEANERS EXCLUSIVELY

THOMAS C. WILSON Inc.

21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

of coveralls that had been hung over a light cord. We had to poke the thing to make sure there was no one in it. The place gave me the creeps. Compared to it a graveyard at midnight would be a cheerful place. I saw the ghosts of the former husky firemen in every worn-out mitt on the floor and in the remnants of every sweater hanging on the wall.

Making our way to the factory building we found the stuff, which we had come to inspect, seized and rusted almost beyond redemption. Three years of neglect had done woeful mischiefs to the building. The walls bulged, the floors heaved and some of the radiators that had not been properly drained, had burst wide open. I looked in at what was once the time office. I recalled the day I received my *first* pay envelope from the hands of courteous Mr Bumner. I wondered if the battered and broken piece of furniture sprawling there could be the highly polished desk that he sat by on that day.

My feet were drawn to a corner of the shop where the teen-age boys and girls used to eat their lunches. Old snapshots of groups of laughing boys and girls in their big shop aprons were tacked to the walls. Some I had taken myself, but I left them there where they belonged. I sat on the old bench and thought of the picnics we had planned there, of the elaborate arrangements we had made for surprise parties and square dances. I wondered what had become of that crowd and of some of the older men who sometimes joined our discussions.

I was wakened from my reverie by the Old Chief calling me. It was a relief to step into the fresh air again. I looked back at the buildings and shuddered. "Doesn't that place look like a thing that has died?" I asked the Old Chief.

He started the car and answered, "That place did not die. It was murdered."

1944 Coal Shortage

(*Continued from page* 69)

normal shutdowns for repairs and replacements. If every one of the 415,000 men now employed appeared for work every day the mines could operate in 1944 and dug 5.2 tons of coal, the total production could be only 604 million tons.

"But it is wholly unlikely that the mine manpower can be sustained at 415,000 men. It is extremely likely

PRODUCTION INCREASED AND...COSTS CUT

Here is the case of a large mid-western steel company that not only increased production, but also cut costs through the services of W. H. & L. D. BETZ. Generating over 10,000,000 pounds of steam per day, this plant was troubled with a severe carryover condition resulting in serious turbine blade deposits. Betz engineers were called in on the job. With special test equipment and with the necessary engineering know-how the trouble was quickly diagnosed and recommendations were made which completely solved the problem.

But Betz engineers did not stop here. Further investigations revealed numerous other phases of water conditioning needing improvement. For example, the coagulant used in the cold lime-soda softener was changed with resulting savings. The internal treatment of the boiler water was revised and an entirely different control established which effected fuel savings of $900.00 monthly through decreased blowdown.

Total savings resulting from these recommendations amounted to over $1500.00 per month. But the most important result of the study, difficult to translate into dollar savings, was the elimination of production losses due to outages caused by improper water conditioning.

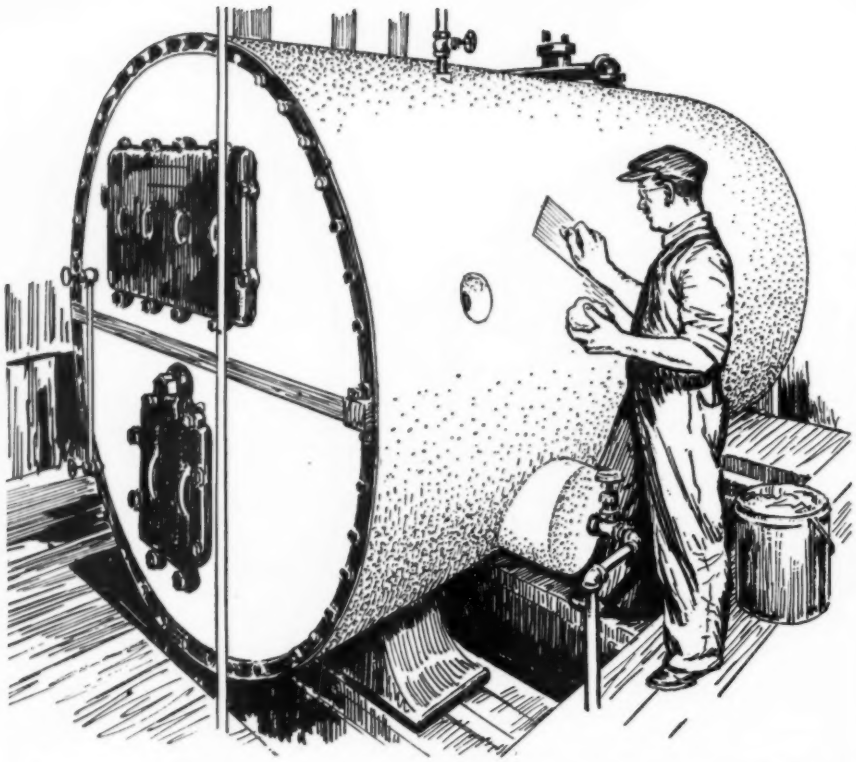
This is a true example of the services rendered to industry by W. H. & L. D. BETZ. It is typical of hundreds of others in our files. It illustrates how a sound engineering approach is always applied to each problem and recommendations are individualized for each case.

We are ready to serve you.

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

W. H. & L. D. BETZ

FRANKFORD • PHILADELPHIA • PENNA.



AN INSULATING CEMENT THAT

stays put

Once it's on, it's on to stay — and that means real savings in time, money, and materials.

Baldwin-Hill No. 1 Insulating Cement contains a special rust-inhibitor that prevents corrosion between metal surfaces and the cement. Whether the cement dries out immediately on a hot surface, or air-dries over a long period of time, it will not affect the bond. Ordinary expansion and contraction of the insulated surface are not problems, either. B-H No. 1 Cement is elastic enough so that it will not crack and peel.

Made of B-H *black* rockwool, it is effective up to 1800° F. It is the ideal maintenance insulation for valves, fittings, and large pieces of equipment where molded-type insulation is not practical. Makes an excellent finish, too, for covering blanket and block applications. Send for sample and information.

Baldwin-Hill Co., 575 Klagg Ave., Trenton 2, N. J. Plants in Trenton, N. J., Kalamazoo, Mich., and Huntington, Ind.

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

that the man-day average has been reduced since 1941, as the average age of miners has been increased about eight years since 1940. It is impossible that every miner will appear for work every day. If allowances are made for present trends, it is estimated that this wholly theoretical figure of 604 million tons will be considerably less."

Manpower loss in the bituminous mines totals more than 75,000 since the war began and the mines continue to lose workers at the rate of 2600 to 2800 a month. About half have been replaced. The men have gone to the armed services and to other war industries. Deferments are in the jurisdiction of local Selective Service boards. The War Manpower Commission conducts recruitment for mine labor replacements.

Breakdown of machinery runs second only to the manpower problem in importance. SFAW has secured from WPB higher preference ratings for manufacture of mining machinery and equipment. The result will be that mines will be served by the entire capacity of the mining-machinery industry not engaged in filling Army and Navy needs or the small amount ($4,000,000 worth) of mining equipment being sent to England. However, it will be several months before the mines begin to get needed replacements on an effective basis.

Stockpiles Decline

To date, the most marked result of these factors has been a progressive decline in stockpiles. In December, 1942, stockpiles in industrial plants and retail yards amounted to a little more than 900 million tons. By October, 1943, this protective supply had dropped to about 73 million. In September alone stocks were depleted by about two and a half million tons; this occurred at a time of relatively light use and before any production was lost by the last general strike or sporadic wildcat work stoppages.

Such a lag under normal war-production conditions demonstrates the hardships war has thrown upon an industry geared to produce a peak of only 400 million tons a year in peacetime—independent of the additional burden of four general work suspensions within the year. According to Administrator Ickes, current stockpiles must be measured against current and future needs rather than against former safe levels.

The situation is tighter for the consumer than production estimates indicate because the coal coming out of

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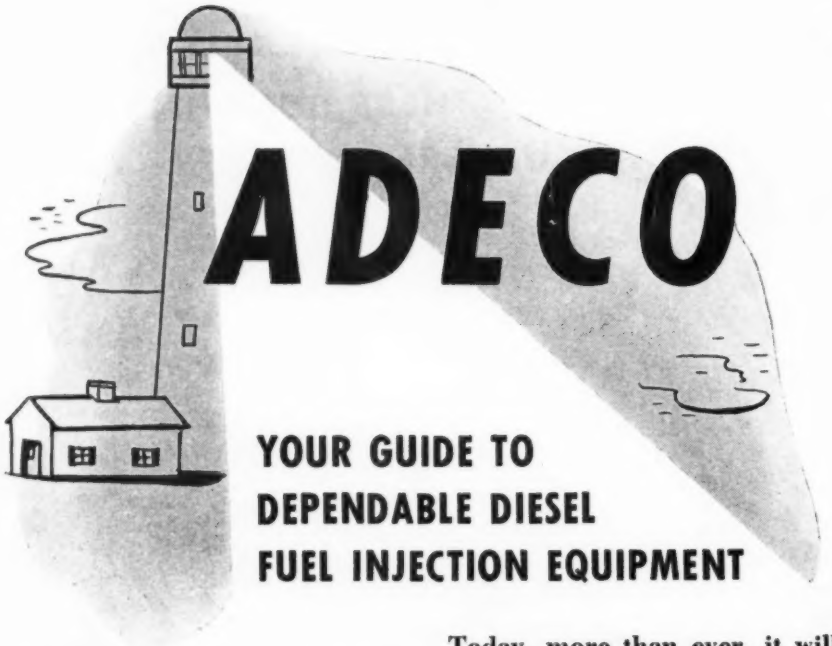

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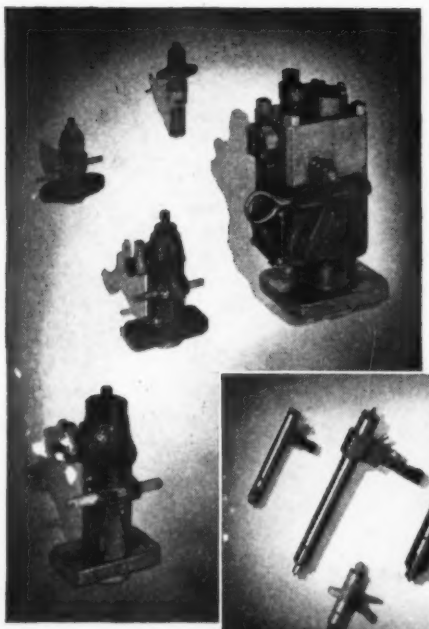

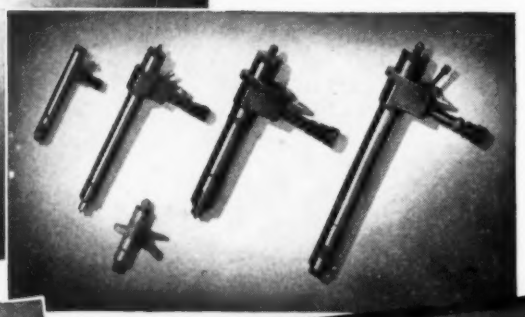

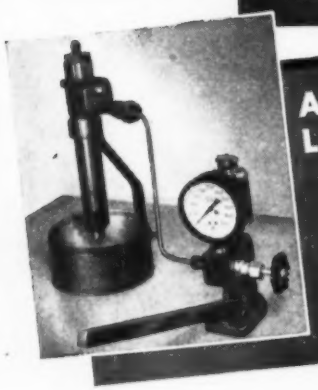

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the mines this winter and the coal already in stockpiles cannot be distributed in accordance with demand as to areas and kinds. A surplus of one type of coal in southern Illinois will not offset a shortage of another kind in Pennsylvania.

New Control Regulations

Prior to new control regulations issued last November, SFAW had issued 4000 separate directives diverting coal from current production or from protective stockpiles to immediate needs of war industrial users and to distressed areas. The new over-all controls limit current shipments to industrial plants, railroads and utilities with relatively large stockpiles, in order to free five million tons a month for household consumers and industries with insufficient supplies.

Provision is made for plants affected by the reduced orders to restore their stocks to safe levels within a few months, if they fall below specified amounts in terms of number of days supply, varying with type of industry. Because there isn't enough coal to meet all demands of civilians and war production. the government's job of controlling consumption is a matter of judicious robbing of Peter to pay Paul. Fuel oil cannot ease the country's coal position because, although it is anticipated that fuel-oil quotas will be met, there will be no excess.

Coal-Saving Program

Several variable factors in both consumption and production may further affect the fuel picture. For example, cooperation by space-heating consumers in the coal-saving program can offset the shortage to the extent of 20 million tons a year, or approximately 10% of all coal used annually for space heating, in the opinion of William A Lyons, chief of the Fuel and Allocations Branch, Office of War Utilities, WPB, and chairman of the inter-agency and inter-industry committees in the over-all program to conserve critical resources. This figure applies to both bituminous and anthracite consumption. Other consumption variables are the weather, unrevealed war needs and the availability of shipping space.

On the production side many variables loom also. Even if no further work stoppages occur, Administrator Ickes still forecasts a lessened production rate, resulting from loss of manpower, partial substitution of older and unskilled labor, wearing out of equipment that cannot be replaced immediately and similar wartime strains.

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Questions and Answers

(*Continued from page* 118)

to the desired thickness, tamped solidly into place and smoothed over so as to leave no seams or rough places. Metal clips are built into the brickwork to hold the plastic lining.

Fig. 2 shows a solid setting wall with firebrick lining.

Q 10—What are buck stays?

A—Used to strengthen and support walls of brick boiler settings, buck stays are long, narrow steel or iron castings, flat on one side with a heavy stiffening rib on the other. They are placed with the flat side against the walls on both sides of the setting and held together by long bolts passing under and across the setting. Two or more pairs of stays support the side walls. Sometimes stays are also placed against the rear walls, with bolts extending the entire length of the setting to the boiler-front plate castings. Fig. 2 shows side stays.

Q 11—What are the disadvantages of the solid-wall boiler setting and what other forms of construction overcome them?

A—The solid-wall setting has two serious disadvantages: the heat loss through the wall is considerable, and the extreme difference in temperature between the wall's outer and inner sides has a strong disintegrating effect on the brickwork. Some wall constructions, Fig. 3, designed to offset these disadvantages without sacrificing too much strength are:

(A) Brick wall having a firebrick lining and an air space between the lining and an outer red brick or second-grade firebrick wall, with long bricks or tiles tying the two walls together at intervals.

(B) Brick wall having a firebrick lining and an outer wall of red brick or second-grade firebrick, with a layer of some kind of special insulating brick between lining and outer wall.

(C) An inner firebrick wall carried on steel bearers, separated from an outer insulated steel casing by an air space through which air circulates constantly.

Wall *A* is much weaker than the solid wall, and the reduction in heat loss is hardly great enough to justify its use. Construction *B* cuts down heat loss and does not weaken the wall to the same extent as the dead air space. The air-cooled setting in *C* is a more efficient construction than either of the first two.

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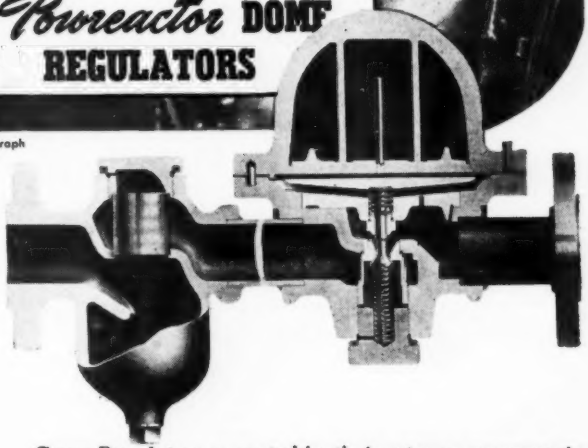

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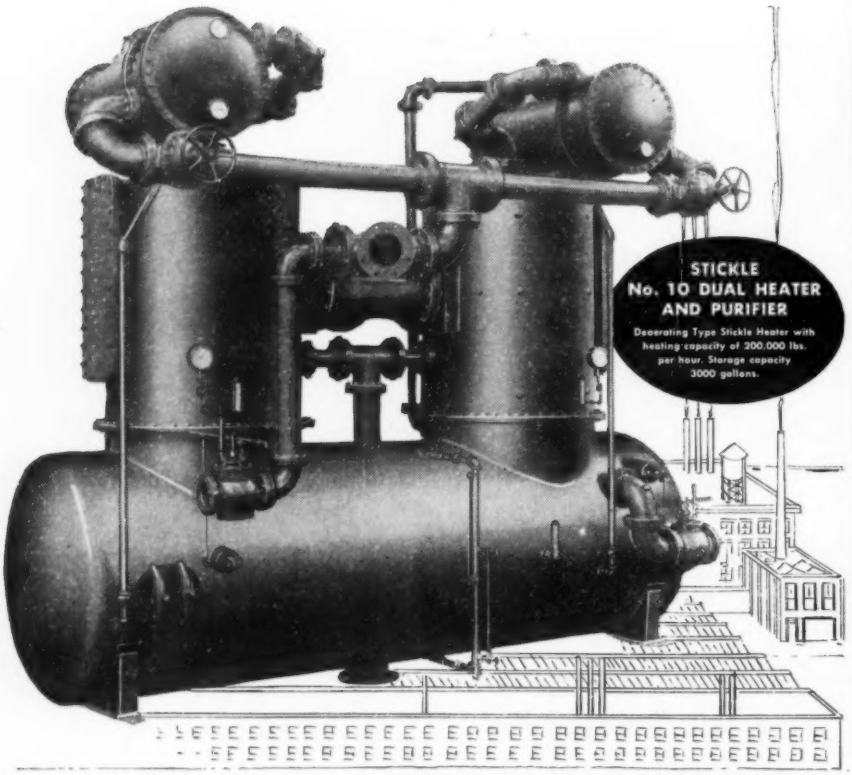
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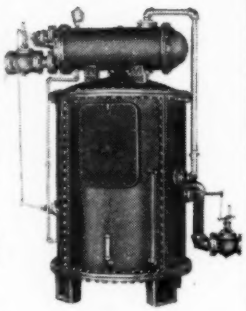

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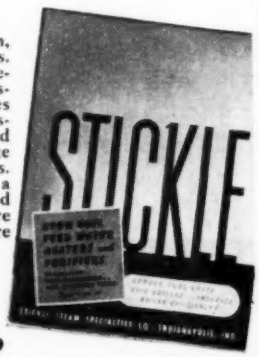

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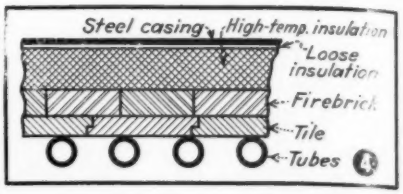


It also serves as a preheater for combustion air.

Q 12—What are waterwalls?

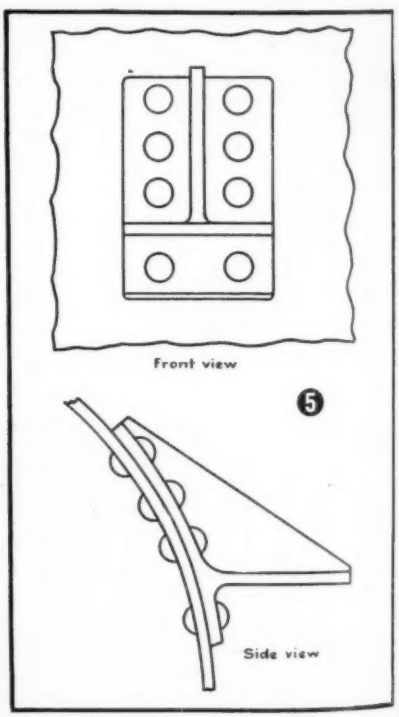
A—They are rows of vertical or inclined watertubes lining the inner walls of boiler furnaces, and connected top and bottom to the other parts of the boiler so that there is continuous, rapid circulation of water through the waterwalls. They provide a large additional area of boiler heating surface and also protect the refractory from the intense furnace heat. Waterwall tubes may be:

(a) Plain tubes set close together to present a metal wall almost solid or spaced a few inches apart, and backed in both cases by a refractory wall. Fig. 4 shows the latter construction.

(b) Tubes having metal fins welded to the sides and installed so that the fins touch and thus expose a complete metal surface to the furnace heat.

(c) Tubes that have a great number of short metal studs welded on their sides and that are backed by and covered with a refractory material so that only the stud ends are exposed to the heat.

In stoker-fired boilers, waterwall tubes at the sides of the grates, and for a few feet above, are often protected by



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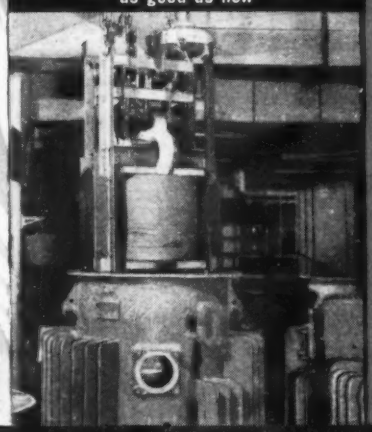

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They came through a $50,000 fire virtually unharmed. Although surrounded by flame, they did not add to the fire.

Several bushings had to be replaced, and tanks repainted—that was all

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The only reconditioning found necessary was the replacement of several bushing porcelains which were cracked by the heat, the painting of the tanks, and the addition of a small amount of new Pyranol to make up for that lost through the bushings.

The transformer interiors were in perfect condition. It was not even necessary to filter the Pyranol.

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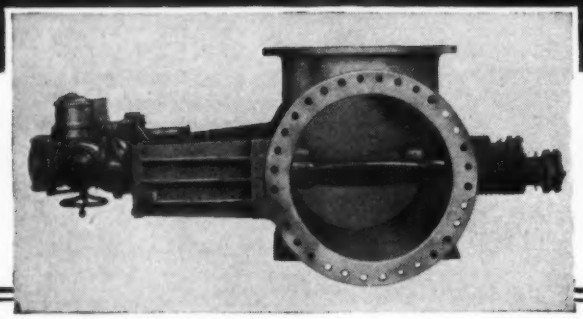

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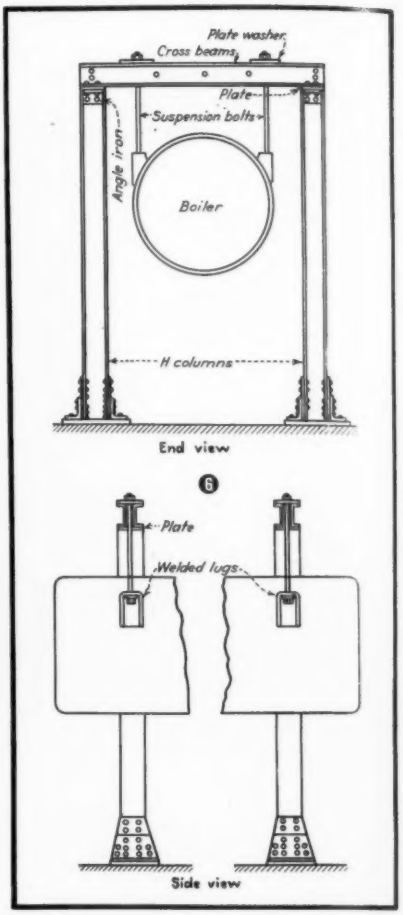

cast-iron blocks bolted to the tubes.

Q 13—How are horizontal-return tubular boilers supported?

A—Up to and including 54-in. diameter and 14-ft length, hrt boilers may be suspended from steel cross beams resting on steel columns set outside the setting walls, or be supported by four steel or cast-iron brackets riveted or welded to the shell and resting on the side walls of the setting. Boilers from 54 to 72 in. diameter may be supported by steel columns, beams and hangers or by eight steel or cast-iron brackets set in pairs, four on each side, and resting on the side walls. Boilers over 72 in. must be supported by the outside suspension method.

With bracket supports, front brackets rest on steel plates set on top of the brickwork, but rollers are placed between rear brackets and plates to confine movement due to expansion and contraction to rear end of boiler.

The bracket support is shown in Fig. 5 and the outside suspension method in Fig. 6.

Q 14—Sketch in detail one method of attaching suspension bolts to the boiler shell.

A—Fig. 7 shows a suspension bolt attached to a steel lug welded to the shell.

(*Continued on page* 170)

CONVOY OIL BURNERS by PEABODY

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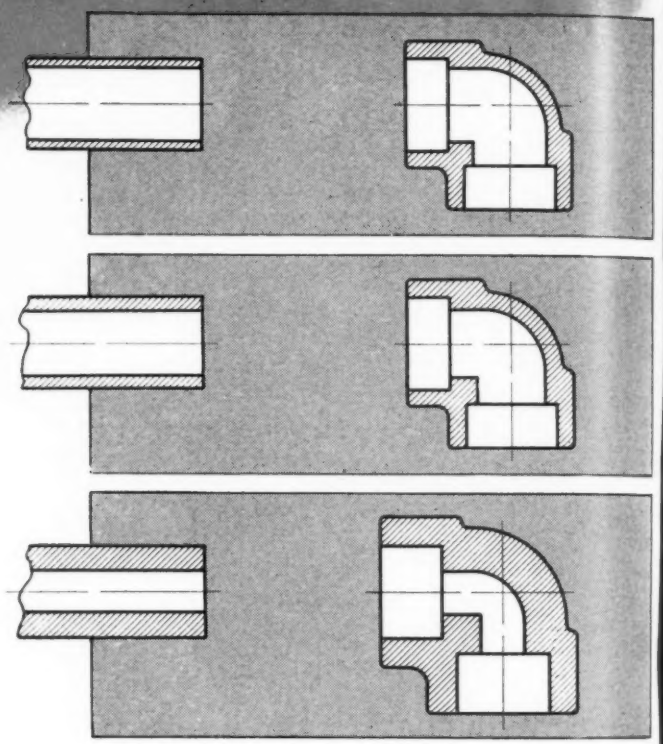

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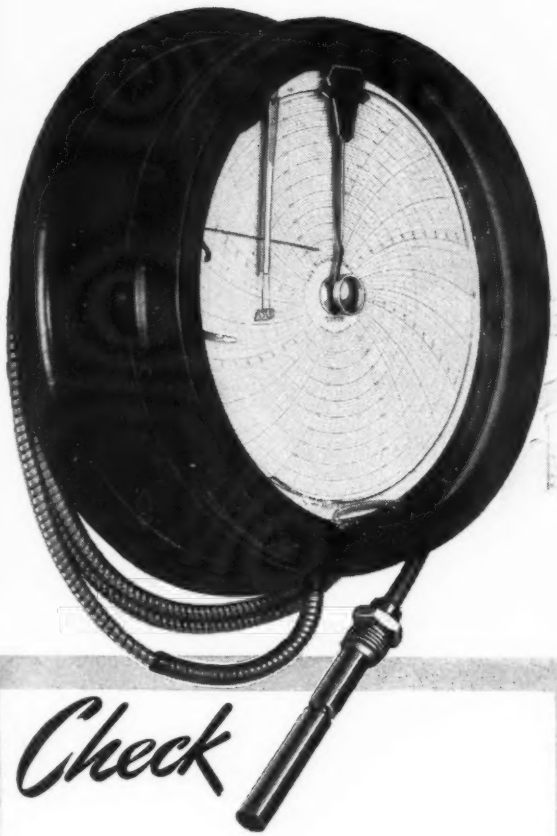

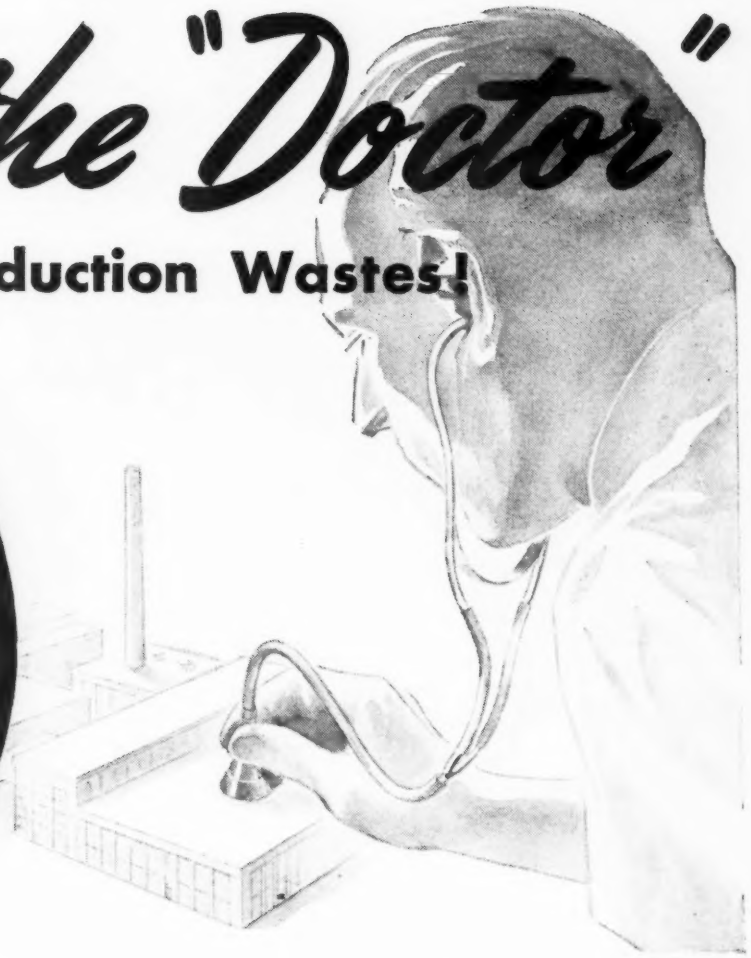

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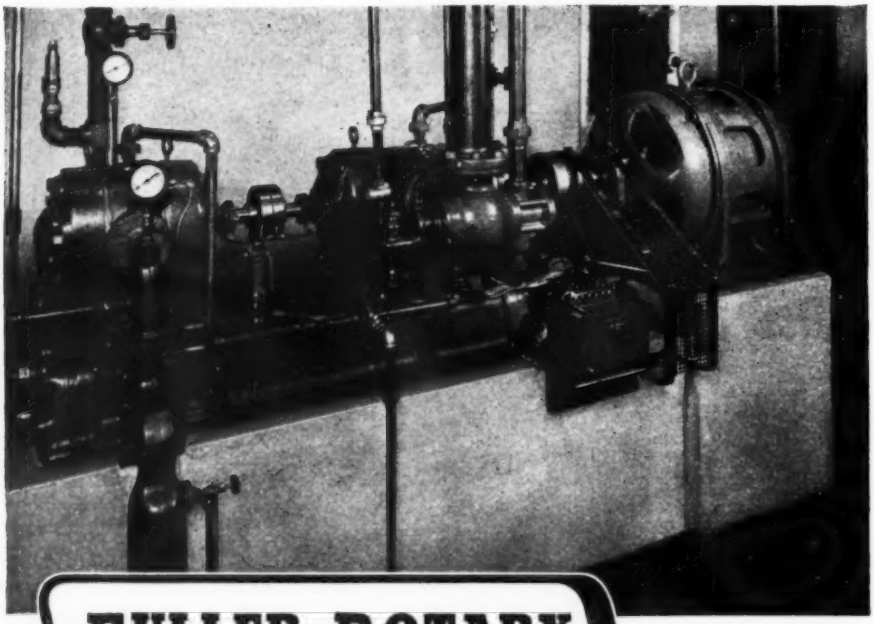

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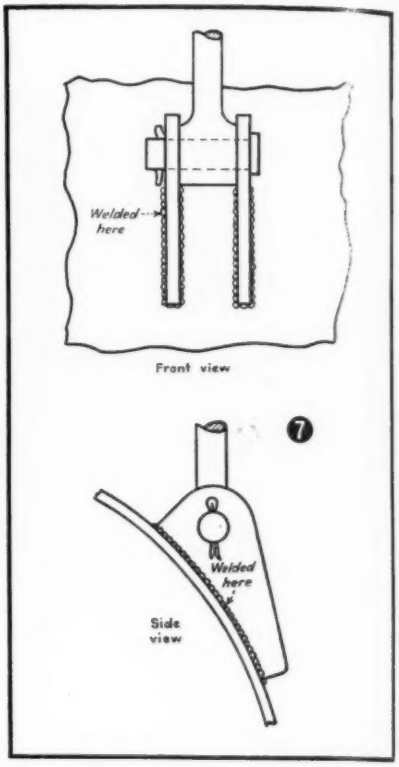
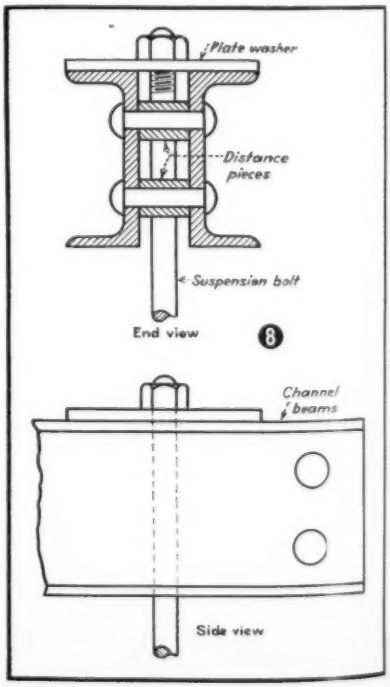


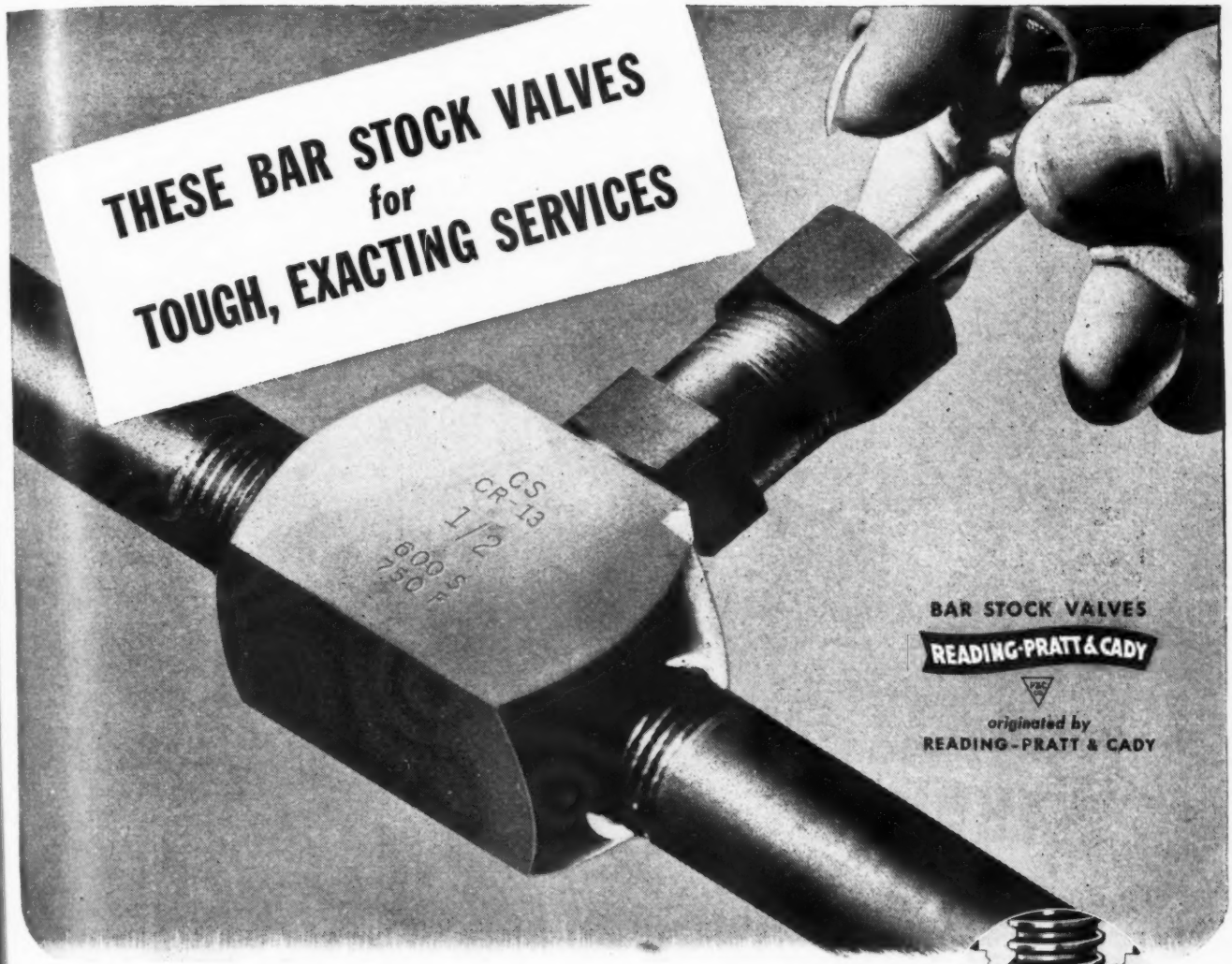
Q 15—Sketch the method of attaching suspension bolts to supporting cross beams.

A—Fig. 8 shows a detailed sketch.

Q 16—Sketch typical foundation bolts.

A—Three foundation bolts are shown in Fig. 9. The hook bolt is easily made, but does not have the gripping power of the rag or wedge bolts. Hook and rag bolts are commonly used where the bolts can be placed in position before the concrete is run. Use the wedge bolt





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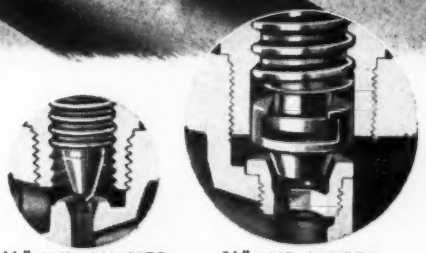

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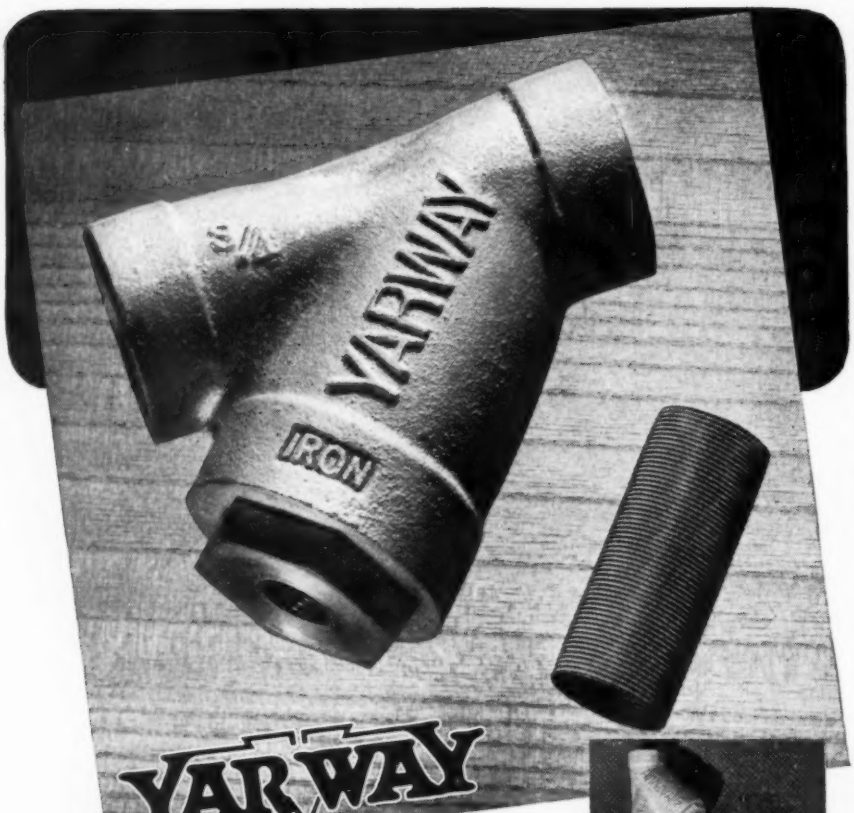

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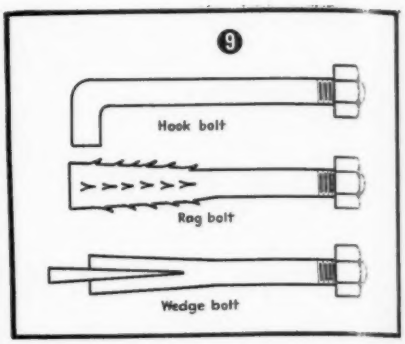

when the holes for foundation bolts have to be drilled in solid concrete. When a wedge bolt is placed in a drilled hole it is driven down on the wedge, taking care not to damage the bolt threads. This expands the split head so that it grips the sides of the hole.

Q 17—When putting a new boiler into service what precautions must be observed with the setting?

A—Start light fire after the boiler has been filled with water. The setting should be allowed to dry out under this light fire for several days. This gives the walls a chance to settle and let any strains equalize. Firing up with a full load on a new setting will almost certainly crack the brickwork and damage the setting badly.

Q 18—What care does a boiler setting need during operation?

A—When the setting has no outer steel casing, give outside of brickwork a heavy coat of paint or cover with a plastic sealing preparation for this purpose, keeping a watchful eye for cracks or breaks. Cracks should be pointed up and broken brickwork repaired at once, for cold-air leakage into the furnace lowers its efficiency considerably. Leakage of gas out through the setting into the boiler room is also objectionable. Give the same care to inside of setting, and repair or reline inner walls whenever necessary.

Readers' Problems

(*Continued from page* 113)

Answers to Dec Question 1

100-psi or higher pressure? If it can't, the inlet line will naturally be submerged until either the water head increases enough to give full discharge or pressure builds up in the tank to force the water out.

Most important point, it seems to me, is to prevent hot discharge into lower layers of cold water with resulting vi-

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Materials
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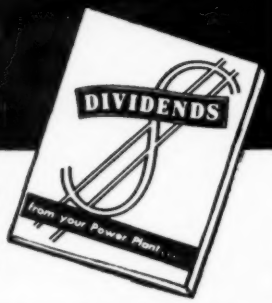

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bration. It stands to reason that blowdown water initially enters the tank faster than cold water leaves.

New York, N. Y. L C RINEHART

Direct Inlet Against Impact Plate

IN ANSWER TO FCT's question a blowdown tank is required to: (1) reduce hot boiler-water discharge to approximately atmospheric pressure, and to separate flash steam from water effectively; (2) dispose of the water either as is or at a reduced temperature; (3) dispose of the flash steam.

For the first requirement, FCT's arrangement *A* has possibilities but *B* is not so good. Incoming water discharges with considerable kinetic energy and this shock must be absorbed to permit rapid separation of water and flash steam without disturbing the water in the tank bottom.

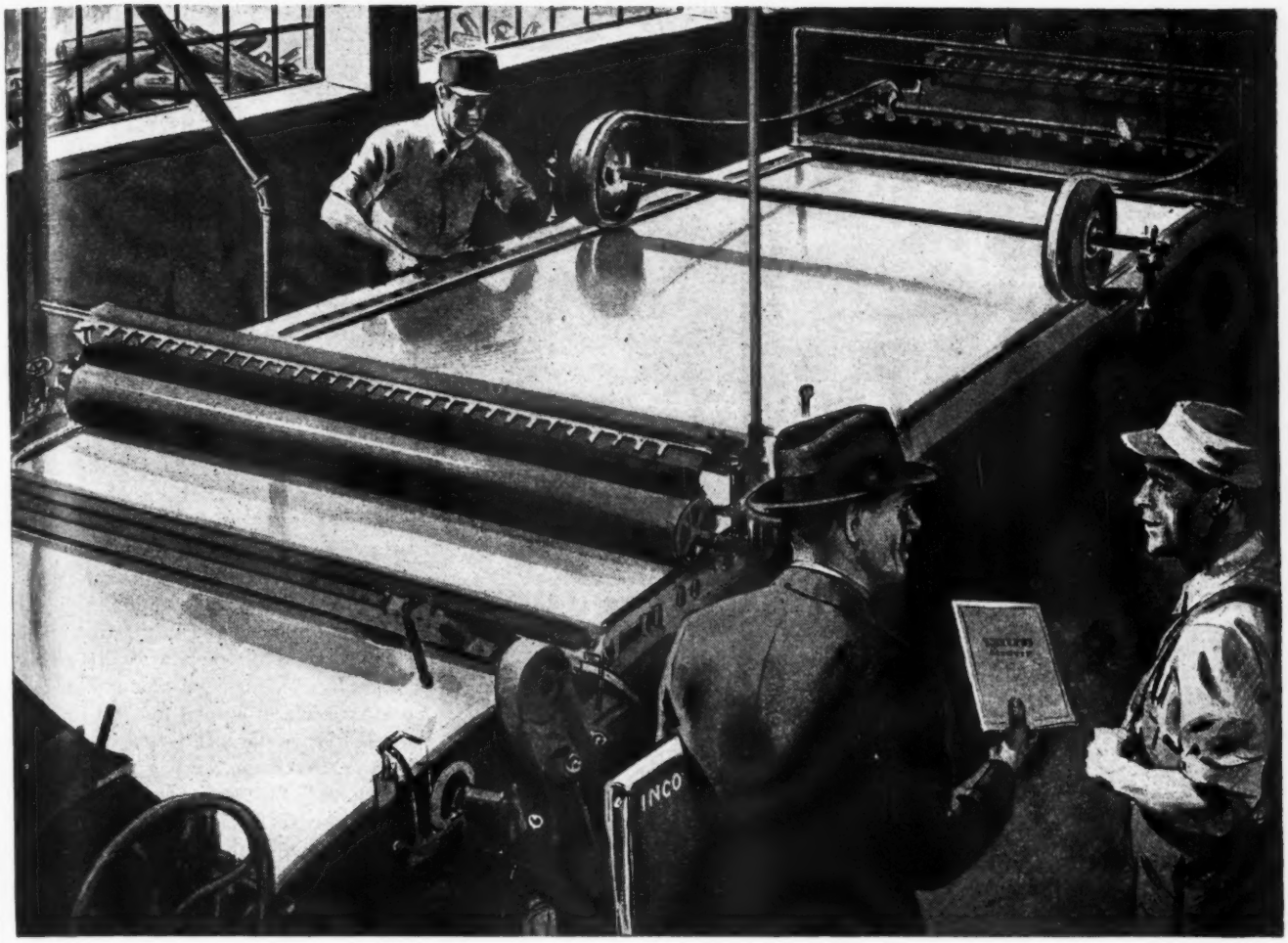
If the inlet enters radially in *A*, it will discharge against the opposite side wall of the tank. There should be an impact plate or, better, an impact hood opposite the inlet to take wear and tear and prevent excessive turbulence. Enlarging the inlet from 4 to 6 in. for a distance of 24 in. permits nozzle expansion and reduces jet velocity. If the inlet is tangential in *A*, we have an effective entrance. This is in effect a cyclone separator which causes the water to swirl rapidly along the tank sides as steam is liberated toward the center and thence to the vent.

Kinetic energy is absorbed by the swirl with moderate disturbance of the stored water in the tank bottom. A liner plate at the inlet level takes wear and tear. Also, enlarge the inlet to reduce jet velocity.

B is faulty since incoming water and steam are directed against the surface of the stored water. This induces excessive turbulence with consequent discharge of steam at the vent. With a horizontal cylindrical tank the incoming jet should be horizontal and directed against an impact plate or impact hood.

If water can be discharged to waste without being cooled below the saturated temperature of the blowdown-tank water, then only a moderate undrained storage space is required, just enough to make a good sediment trap. Provide a water sealed overflow connection with the bottom of the elbow at desired water level. It is wise to prevent siphoning; discharge-line siphon breaker shown in *B* will serve.

If necessary to cool the effluent water, provide a much larger storage space. Lower end of the water-sealed discharge



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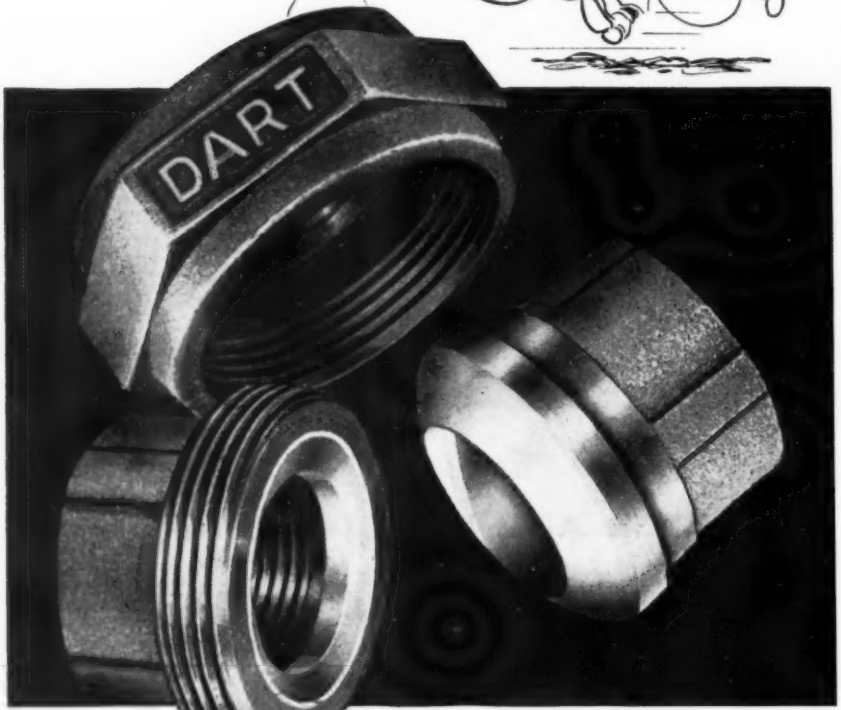

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DART UNIONS

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pipe should extend well toward the bottom so that lowest-temperature water is discharged, while providing a mud-and-sediment collection space underneath.

A further design variation is sometimes used. The incoming blowdown discharges under the water level through an injection head that induces rapid circulation of the water stored in the tank and raises its temperature by condensing the flash steam and by mixing the incoming hot water. Storage space must be large enough to keep water temperature down to the required limit. This eliminates the impact plate and flash hood and very largely reduces need for a vent.

A portion of the blowdown always flashes into steam as the pressure reduces from that of the boiler to that of the blowdown tank. This steam may be disposed of with an injection head, or it can be discharged from the vent. Here, make the vented steam as dry as possible by utilizing a suitable impact hood and venting at a point farthest from the splashing water. If water drains to a sewer, make the vent large enough to permit flash-steam discharge without undue pressure rise in the tank. Under certain conditions, especially if boiler pressure is high, it may be desirable to use the flash steam, which should be as dry as possible.

A bottom mud drain is desirable. Drain valve should be next to the tank and not at a distance as shown in *B* since mud and scale tend to block the dead end. Space above the permanent water level should provide room for steam and water separation above the temporarily elevated water level toward end of blowing period.

San Francisco, Calif. M S GEREND

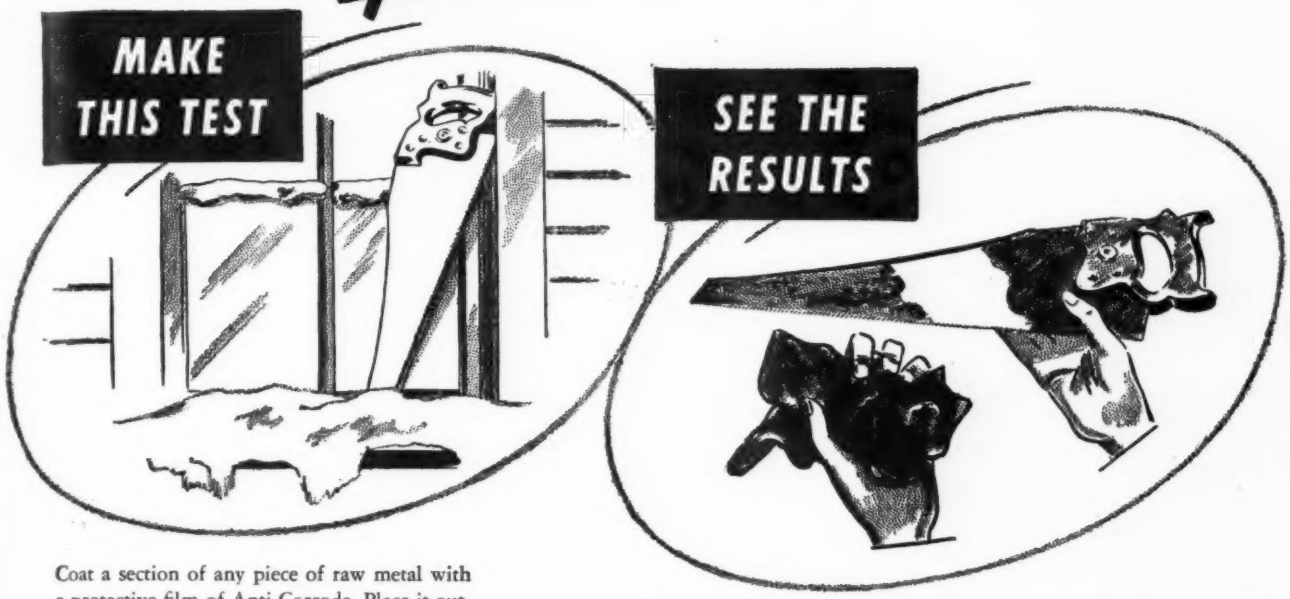
Answers to Dec. Question 2

(*Continued from page* 113)

Drying by contact with superheated steam is simply evaporation at full vapor pressure. At atmospheric pressure, free saturated evaporation takes place at 212 F. When the surface becomes dry, skin temperature rises above 212 F with a temperature gradient into the solid where free evaporation is still taking place. The driving force which causes drying under these conditions is heat absorption by radiation and convection at a temperature of 212 F, or higher, as compared to heat absorption at or close to the wet-bulb temperature of the drying air. From this it follows that the drier's capacity would decrease as the air's humidity increases up to the point where pure superheated steam recirculates as the drying agent.

If some of the moist air is returned

How to *prevent* Corrosion



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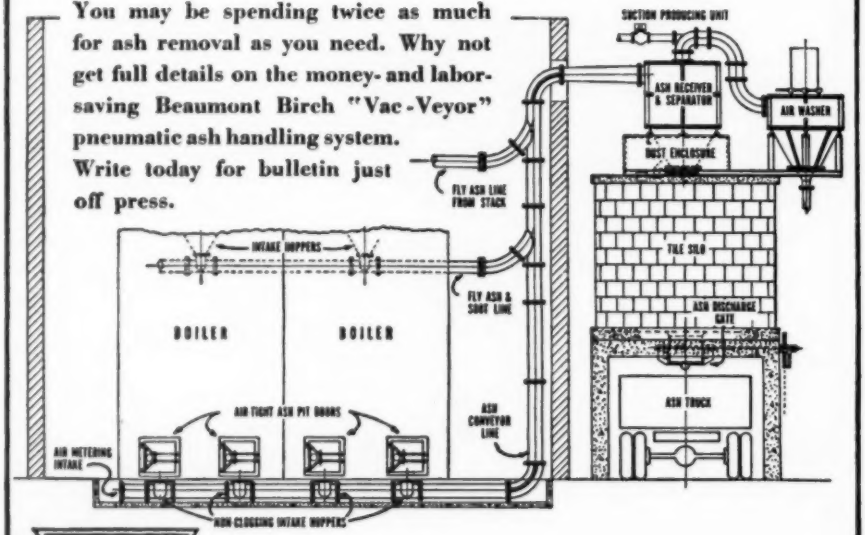

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from the outlet, air entering the drier contains more moisture and therefore drying is slower. Further, since exhaust air from the drier is warmer than inlet air, recirculation increases the entering temperature and tends to decrease the drier's steam consumption.

As far as thermal efficiency is concerned, using straight recirculated superheated steam in the drier is much the best since, neglecting radiation losses, rejected heat is limited to heat added to moisture removed from the stock, plus heat absorbed and retained directly by the stock.

Economical operation of a drier is, however, governed by more factors than thermal efficiency alone. Drier capacity increases as humidity of the drying means decreases, and the lower temperature exposure of the stock when drying with air may be important. Humidity of the air increases as it approaches the air outlet. This tends to diminish the drying rate toward the end of the air cycle, all of which may be of importance in preserving the stock from harm.

San Francisco, Calif. M S GEREND

Exhaust Fan Unnecessary

AN EXHAUST FAN is unnecessary in BG's drying room if he installs a vent to atmosphere.

Room temperature is definitely fixed between 225 and 320 F by pressure controllers. Assuming the pressure to be atmospheric at first, evaporation must take place, because vapor pressure is below saturation. Evaporating moisture occupies a certain volume, and unless a similar air or vapor volume escapes from the room, pressure will rise until the saturation point is reached and condensation begins. If this condition occurs, evaporation ceases.

A vent to atmosphere allows sufficient vapor to escape to maintain the atmospheric pressure, and moisture evaporates continuously in the drying room, even though the room soon contains a vaporous atmosphere with very little air. Amount of moisture removed from the boards is controlled by length of time they are exposed to heat.

West New York, N. J.
FRANK DI LORENZO

Suggests Dehydration

BG HAS OVERLOOKED something. Think of it this way: Moisture must be removed from the wall board. Mechanically this is accomplished by vaporizing the water, and transferring it from the product to the surrounding heated air. Obviously, starting with cold air at an

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average relative humidity (it becomes lower as air temperature increases) the point is soon reached when the air is saturated. Beyond this no further drying can be accomplished. Air is simply the vehicle that transports moisture away from the product.

It is evident that only one thing can be done—the capacity load of moisture in the drying room must be reduced. Two methods suggest themselves: (1) dehydration, if for any reason the same air must be re-used; or, more probably, since air is plentiful, (2) discarding the air with its capacity load of moisture and replacing it with fresh, unsaturated air. The quantity of makeup air thus required varies, of course, with its relative humidity.

It is apparent that raising the temperature of this constant influx of fresh air entails some expense in additional fuel. BG can check this expense against fixed charges plus the operating and maintenance expense on necessary dehydrating equipment, and adopt whichever method proves more economical.

Tecumseh, Kansas H M NAYLOR

Explains Three Drying Processes

IN THE PULP AND PAPER INDUSTRY there are three drying systems: (1) Ordinary dryers are open to the air with either a gravity ventilating system or mechanical vapor removal. If relative humidity rises above the condensation point, dripping results. Sometimes heated air is blown into the nest of dryers to increase circulating air's capacity to pick up moisture from a sheet of paper.

(2) In the Minton vacuum dryer, paper and dryers are entirely contained in a cast-iron vacuum chamber. Usually 28-in. vacuum is carried on this system resulting in fast and efficient drying of paper and pulp at low temperatures.

(3) Chamber system encloses the dryers but instead of a vacuum, a pressure slightly above atmospheric is built up and escaping steam is used in another part of the drying process. This system is rather new and no work has been done on it since the early days of the war. Air is absent in this system.

BG is on the right track. The paper industry uses air to prevent condensation of vapor, but would like to be free of it.

Hot dry air can pick up considerable moisture. Circulating hot-water vapor is not of particular value unless the vapor is superheated; then the only effect is to raise the temperature of the article being dried.

Toronto, Ont. J C NUTTER

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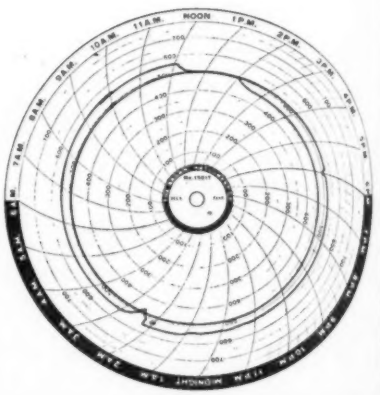

Stack temperature charts superimposed to show improvement in operating efficiency produced with XZIT. Before XZIT-temperatures—500 to 550 deg. Tubes blown every 12 hours. After two weeks with XZIT-temperatures—450 to 500 deg. Tubes blown once daily.

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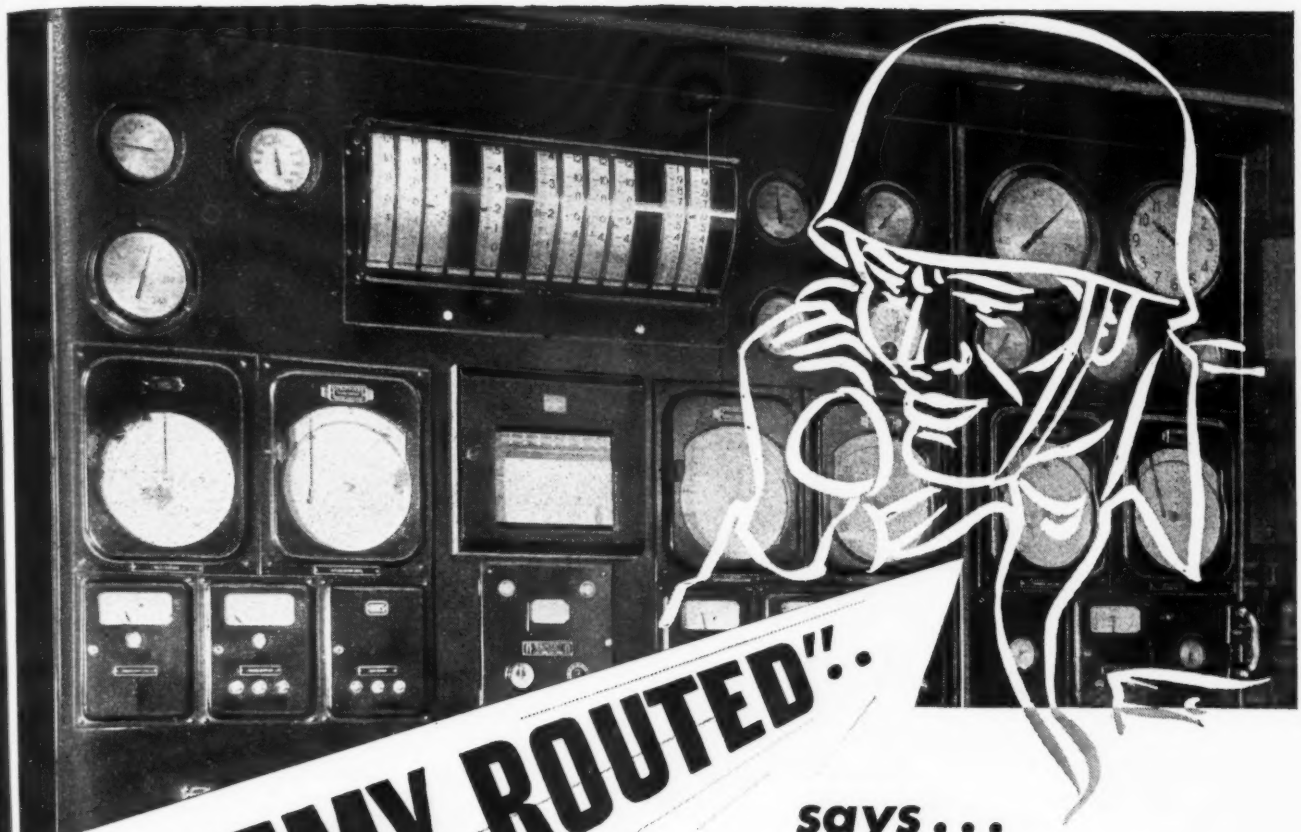

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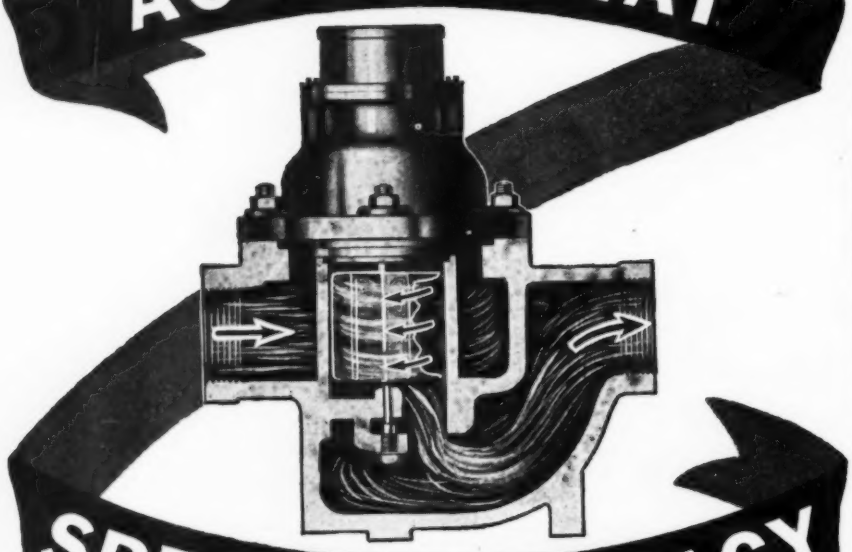
ACTION THAT



SPELLS ACCURACY

IN THE

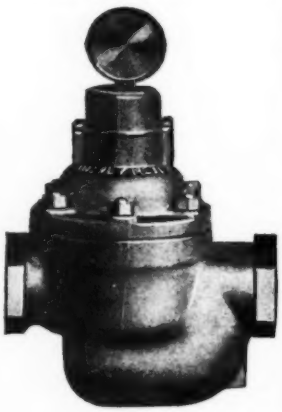
HENSZEY *Feed Water* METER

The water or liquid to be measured enters the measuring chamber tangentially, spinning in the chamber as it passes through, forming a vortex. Each gallon that passes through this chamber makes the same number of revolutions of the water. The vane in the rotating water imparts the rotation to the register.

Yes—it's as simple as that. No close clearances . . . no complicated mechanisms—all of which means dependable, accurate measurement of such hard-to-measure liquids as boiler feed water, boiler blowdown, condensate, chemicals and other similar liquids.

If you have a measuring problem, send it to us—you'll get a practical answer.

- No structural supports needed—they are placed right in the line.
- They measure the pulsating discharge of reciprocating pumps.
- The entire mechanism can be removed without removing the body of the meter from the line.
- No close clearances at any point.
- Calibrations can be made to read in Gallons, Pounds or Cubic Feet at any specified temperature.
- Sizes: 10 to 600 GPM cold water, steady flow rating. Special sizes to order.



HENSZEY COMPANY

Dept. D-2 Watertown, Wis.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers

Flow Indicators • Boiler Feed Regulators • Proportioning Valves

Lists Evaporation Requirements

EVAPORATION FROM MATERIAL in a dryer depends on: (1) vapor pressure of the water in the material being treated, (2) vapor pressure of the water in the air in contact with the material, and (3) velocity of the air in contact with the material.

For a given condition of ventilation, evaporation is thus proportional to the difference in vapor pressures of the water in the air and material being dried.

If moisture does not leave the system, drying will cease when the two vapor pressures become equal. BC can calculate when this would occur. Wet- and dry-bulb thermometer readings at various locations allow the vapor pressures of the moisture in the air to be determined directly from psychometric charts, which are readily available. If moisture is removed to control humidity of recirculated air, exhaust can be reduced or stopped. Most economical combination of recirculation, admission and exhaust, can only be determined when all factors are known.

Superheated moisture carries a definite amount of heat as does the air and vapor mixture, but here the drying rate requires close control of moisture quantity in air passing the material being processed.

Saint John, N. B. C G CLARK

Ventilation Carries Moisture Away

VENTILATION must be maintained in BG's drier to carry away excess moisture that is evaporated and allow the product to reach full temperature.

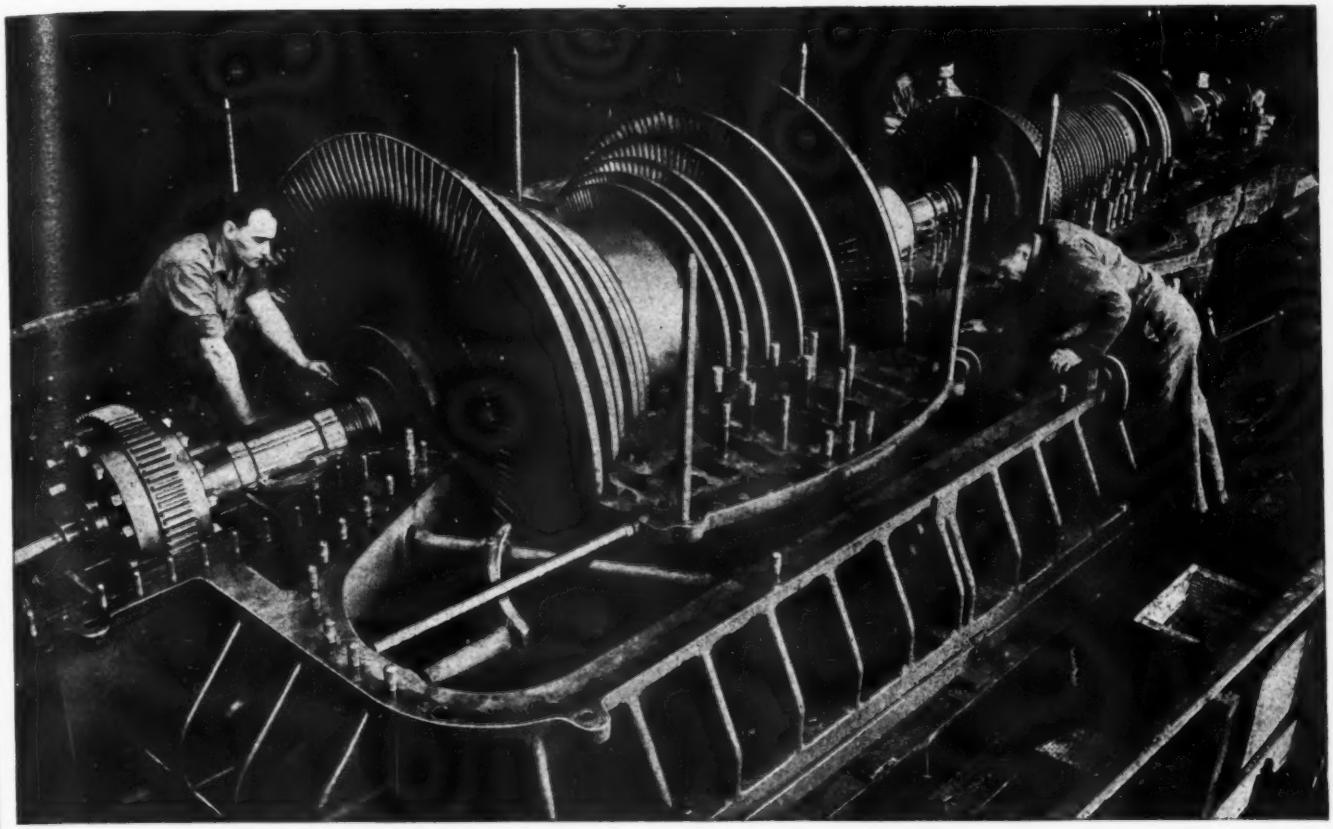
BG seems to think that as long as temperature is above 212 F, moisture or condensate should not accumulate, or that as long as temperature remains above this point, condensate should be hardly noticeable. This is wrong because there is an exchange of heat for moisture and circulation must carry the vapor away.

He should check the steam temperature at the kiln entrance; if piping is exposed to the weather, considerable condensation may take place before steam enters the kiln.

Exhausting the hot air and moisture gives a better heat exchange.

Air circulation by fans will aid the rapid evaporation of excess moisture from the plaster wall board.

Philadelphia, Pa. T F CUNNINGHAM



Stainless Steel Turbine Buckets

Don't Get The "Creeps"

The life of a steam turbine bucket is not easy. Superheated steam strikes against the bucket with such force that, in some cases, it whirls at a rim speed of 600 miles per hour. The combination of high heat from the steam and centrifugal stresses from the speed will cause most metals to grow, or "creep." But if a turbine bucket creeps even a few thousandths of an inch in its limited clearance, it renders a turbine useless.

Most metal buckets travelling at such speeds will pit and erode under impact of the steam and the droplets of condensed water.

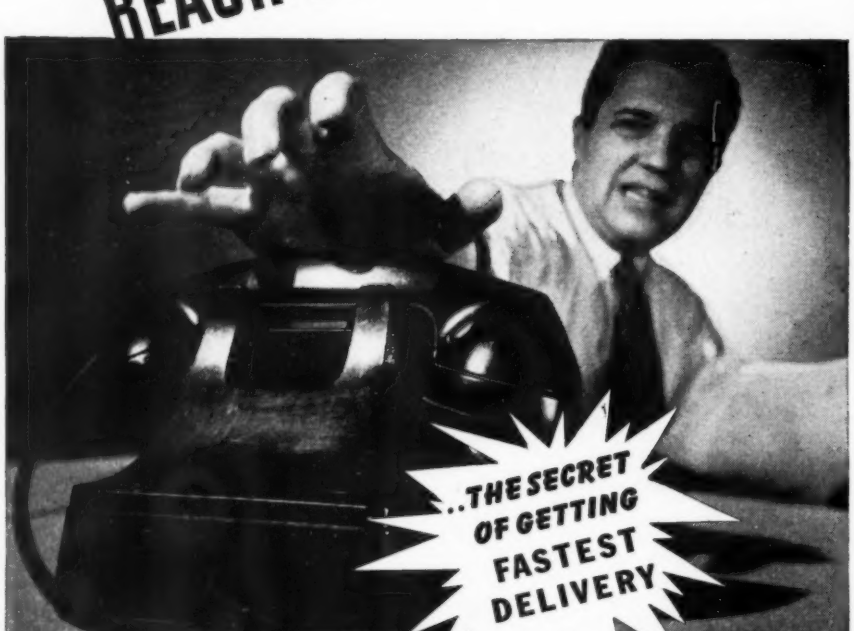
When the turbine bucket is made of stainless steel, the story has a different ending. *Stainless steel turbine buckets resist creep, pitting, and erosion to give dependable service over a long period of time.*

We do not make stainless steels, but we produce chromium and other ferro-alloys that give steels their strength and toughness. Our metallurgists have a background of over 35 years' experience with alloy steels, both in the laboratory and in the field. If you have a problem in the selection or use of an alloy steel, consult us.

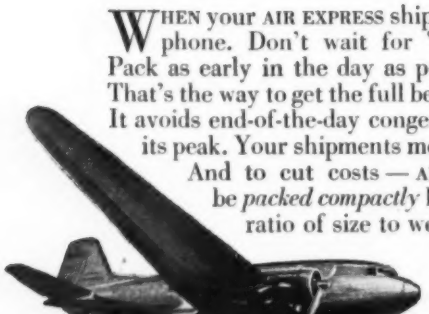
ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

Electromet
Trade Mark
Ferro-Alloys & Metals

SHIPMENT READY? REACH FOR THE PHONE!



WHEN your AIR EXPRESS shipments are ready, reach for the phone. Don't wait for "routine" afternoon pickups. Pack as early in the day as possible and SHIP WHEN READY! That's the way to get the full benefit from AIR EXPRESS service. It avoids end-of-the-day congestion when Airline traffic is at its peak. Your shipments move faster, are delivered faster. And to cut costs — AIR EXPRESS shipments should be *packed compactly* but securely, to obtain the best ratio of size to weight.



A Money-Saving, High-Speed Tool For Every Business

As a result of increased efficiency developed to meet wartime demands, rates have recently been reduced. Shippers nationwide are now saving an average of more than 10% on Air Express charges. And Air Express schedules are based on "hours", not days and weeks — with 3-mile-a-minute service direct to hundreds of U. S. cities and scores of foreign countries.

WRITE TODAY for "Vision Unlimited" — an informative booklet that will stimulate the thinking of every executive. Dept. PR-2, Railway Express Agency, 230 Park Avenue, New York 17, N. Y.

AIR EXPRESS
Gets there FIRST

Phone RAILWAY EXPRESS AGENCY, AIR EXPRESS DIVISION
Representing the AIRLINES of the United States

Power Lines

(*Continued from page* 130)

ful maintenance and cannot resist corrosion or stand up as long. When Standard is again obtainable, EAS will be withdrawn. Its units now include pump tank and foam types. Many go to priority holders but some to the general public.

Both labels indicate to **insurance inspectors** degree of protection the equipment affords an occupancy. They are comparable indications of reliability to owner or prospective purchaser of fire-fighting equipment.

Commonwealth Edison Co placed in service Dec 20 a new 147,000-kw turbine-generator at its Fisk station. The machine is the largest unit built in this country since the beginning of the war.

The new **Fisk generator** feeds energy into the power pool embracing territories served by Commonwealth Edison, Public Service of Northern Illinois, Western United and Illinois Northern Utilities. Aggregate system net capacity is now 2,254,000 kw, with a peak load to date of 1,928,000 kw registered December 15. Two pulverized coal-fired boilers have a combined capacity of 1,500,000 lb steam per hr. Allis-Chalmers Mfg Co constructed the turbine-generator and Babcock & Wilcox Co the boilers.

Testimony of Douglas G Wright, acting administrator of Southwest Power Adm, lifted the censorship veil on the location of the first of the four **floating power plants** ordered by WPB and financed by Defense Plant Corp. The 30,000-kw unit has been located since its recent launching at Vicksburg.

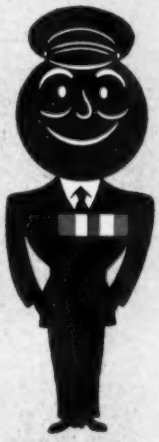
Heaps Engineering (1940) Ltd, New Westminster, B. C., has secured exclusive rights for Canadian manufacture of **Atlas engines** from Atlas Imperial Diesel Co, Oakland, Calif. Engine production commenced early in December. Recently the company was awarded a contract from Ottawa for ten Atlas engines to supply power to vessels being built in British Columbia. It is reported that material for the diesel engines is rolling from eastern Canada and actual construction from blueprints is expected shortly.

Defense Plant Corp has selected Harleyville, S. C. for the country's first **aluminum-from-clay pilot plant.** WPB

PHYSICAL AND CHEMICAL PROPERTIES OF "dag" COLLOIDAL GRAPHITE

Available as a smooth, black, liquid concentrate, Dag colloidal graphite puts a versatile company of physical and chemical properties at your service. Fifteen of the more important of these properties are listed here with a different color given to each for easy reference.

Match these properties by color with the colors on the medals below. Each medal represents a typical performance "citation" to Dag colloidal graphite. Dozens more could be shown, if space permitted, because this product is a dry film, a fluid film, a surface coating, an impregnation—and a few other things besides.



"Mr. Dag"

1 Slippery—a Good Lubricant. Softer than talc

2 Conducts Electricity

3 Withstands Temperature Extremes

4 Absorbs, Radiates and Conducts Heat

5 Maximum Purity

6 Low Coefficient of Expansion

7 Particles Bear Like Electric Charges

8 Insoluble in Acids and Alkalies

9 Black and Opaque

10 Gas Adsorbent

11 Little Photoelectric Effect

12 Miscible with Most Fluids

13 Films Adhere Tenaciously and Dry with Sharp Edges

14 Microscopically Fine Particles.

15 An Excellent Suspension

2 14 13 15

2, 14, 13, 15
CITATION: "Drive belts and other nonconductors traveling at high speed accumulate static charges which under certain conditions may constitute a hazard. This static electricity is controlled and bled-off harmlessly by a Dag colloidal graphite conductive film."

1 3 5 14 15

1, 3, 5, 14, 15
CITATION: "When the work rotating chuck of this large honing machine was assembled and run-in using Dag colloidal graphite, running-in time was reduced approximately 35%, operating temperature dropped considerably, and the danger of bearing damage due to temporary oil film failure was eliminated."

9 13 6 14 15

9, 13, 6, 14, 15
CITATION: "Dag colloidal graphite is used to retouch photograph negatives because of its complete opacity, because a film of minimum thickness is required and because it dries with a sharp edge."

PIN A MEDAL ON YOURSELF!

CHECK THE LIST and pick out those properties which you can use. Then state your problem to us and let our engineers give you the benefit of their experience. It is quite possible that they have already studied a parallel application. You'll pin a medal on yourself for calling in Mr. Dag.

Dag, Oildag, Aquadag, Castordag, Glydag and Prodag are registered trade marks of Acheson Colloids Corporation. Copr. 1944 by Acheson Colloids Corp.

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION

PORT HURON, MICHIGAN

CHECKING ALIGNMENT IN OUR SHOPS

TO SAVE YOUR TIME IN ERECTION

Misalignment and dimensional variation in piping subassemblies delivered to the job can cause considerable trouble and expense . . . and much lost time in field erection. It is a nuisance you need not tolerate.

Midwest takes no chances in this important matter. Every pre-fabricated subassembly is checked for dimension and alignment with utmost care. Any inaccuracies which this check discloses are corrected before shipment is permitted. As a result, Midwest Pre-Fabricated Piping is erected easily and rapidly.

Other time-saving and trouble-saving advantages of Piping by Midwest are the thorough cleaning to remove all scale, dirt, etc. before shipment . . . and the most careful inspection and shop testing.

★ ★ ★

Midwest Piping Service can be used to advantage whenever you need piping . . . whether a simple pipe bend or a complex high pressure piping job. Three modern fabricating plants are strategically located to serve you . . . and an experienced Erecting Division will take full responsibility for a complete piping installation.

MIDWEST

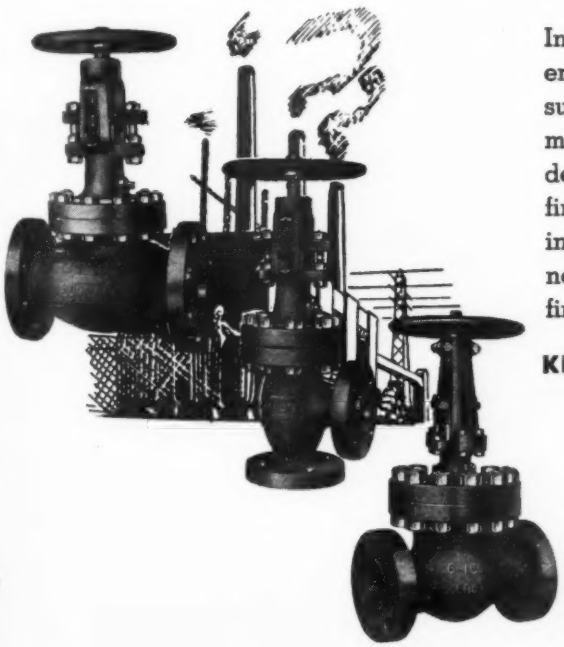
MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division 30) Church St. • Tulsa—533 Mayo Bldg.

and Kerotest Valves do the job!



Instant, certain and smooth response to emergency needs is an absolute "must" for submarine valves—and every step in Kerotest manufacture of these products perfects their dependability. Our experience in building fine oil field valves helps mightily in producing Marine Valves today . . . just as today's new research and facilities will assure you finer industrial valves tomorrow!

KEROTEST MANUFACTURING COMPANY
PITTSBURGH, PENNSYLVANIA

KEROTEST
REGISTERED U.S. PAT. OFF.

ALWAYS BE CAREFUL WHEN REPLACING OR REMOVING HEAD GASKETS
RIGHTO! GASKETS THAT ARE TOO THICK OR TOO THIN CAN CAUSE TROUBLE!
NUMBER FIVE OF A SERIES

How To Get The Most Work Out Of Your VIKING PUMPS

If it ever becomes necessary to dismantle your Viking Rotary Pump, do not use thicker gaskets than those originally furnished with the pump when putting it back together again. Use of thicker gaskets will allow end play and slippage, decreasing the pump's capacity and efficiency. In replacing gaskets, be sure they are not broken or leakage may occur. Also be sure that the pump does not bind because of lack of gaskets.

For valuable help in installing, operating and maintaining your pumps, write today for your FREE COPY of the Viking Service Manual. It's a handy, illustrated booklet packed full of practical information. Get *extra* wear out of your pumps by giving them *extra* care. The Viking Service Manual tells you how.

VIKING PUMPS — FIRST IN AMERICA

VIKING Pump COMPANY
CEDAR FALLS, IOWA

FOR FLUID-PRESSURE SYSTEMS

LONERGAN MODEL "GH" HYDRAULIC GAUGE

A heavy—duty gauge for indicating pressures on fluid systems. Made in standard 4½", 6", 8½", and 12" sizes. Furnished with various dial scales from 0/1000 to 0/30,000 lbs. Bored, micrometer-sized alloy steel tube with phosphor-bronze bushed movements.

The Model GH pictured here is one of our complete line of precision devices, recognized for over 70 years for quality and dependability. Write for complete catalog.

Lonergan

J. E. LONERGAN COMPANY, 2nd & RACE STS., PHILA. 6, PA.

SAFETY VALVES • RELIEF VALVES • PRESSURE GAUGES • SPECIALTIES

has approved use of required material and construction is under way. The experiment, if successful, will free us from our present dependence on foreign bauxite. Daniel Construction, Inc is the contractor.

National Safety Council's Award for top place in safety went to the Bethlehem plant of **Bethlehem Steel Co** for the second time in three years. It was in recognition of fewest lost-time accidents in the group of 25 leading steel companies.

Two more TVA projects of the 1945 power program have been granted AA-3 priorities and will be scheduled for completion as soon as possible: (1) a 32,000-kw hydro unit for the Kentucky dam, its fourth such generator, (2) a 60,000-kw steam unit at Watts Bar steam plant, its fourth generator.

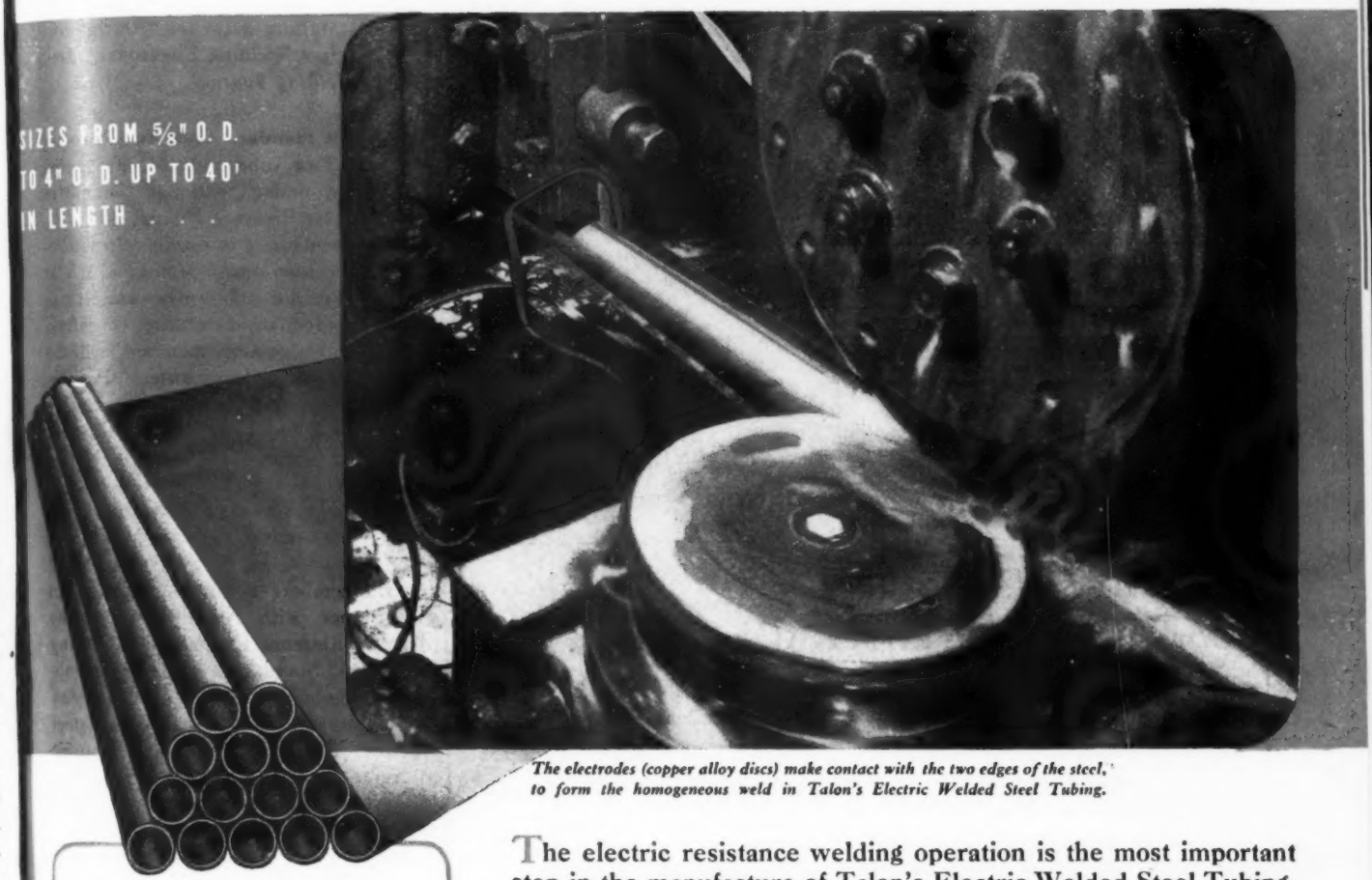
The Lincoln Gold Medal was awarded to Gilbert E Doan, professor of metallurgy and head of dept of metallurgy; Robert B Stout, instructor in metallurgy; John H Frye, Jr, associate professor of metallurgical engineering—all of Lehigh University and co-authors of "Preserving Ductility in Weldments," July, 1943 *Welding Journal*, judged the greatest contribution to the advancement and use of welding of the year.

Resistance Welder Mfgrs Assn awarded annual prizes: University Prize $100 to W F Hess, asst professor in metallurgical engineering and head of welding laboratory, and D C Herrschaft, both of Rensselaer Polytechnic Institute for, "The Spot Welding of 0.040 in. SAE X-4130 Steel," Oct, 1942, *Welding Journal*. Industrial Prize $100: Richard Della-Vedowa, production research dept, and Mabel M Rockwell, production research engineer, both

HAD BETTER SELECT HIS GLASS EYES WHILE HE CAN STILL SEE 'EM'
HERE'S A POPULAR NUMBER — WE CALL IT "LAUGHING HAZEL GREY"
GLASS EYES
GLASS EYES DEPT.
NATIONAL SAFETY COUNCIL

And Now I Pronounce You

TALON'S ELECTRIC WELDED STEEL TUBING



The electrodes (copper alloy discs) make contact with the two edges of the steel, to form the homogeneous weld in Talon's Electric Welded Steel Tubing.

Interesting Facts About Joining Talon's Electric Welded Steel Tubing

Joining Talon's Tubing offers no drawback because almost any conventional method can be used, such as the following:

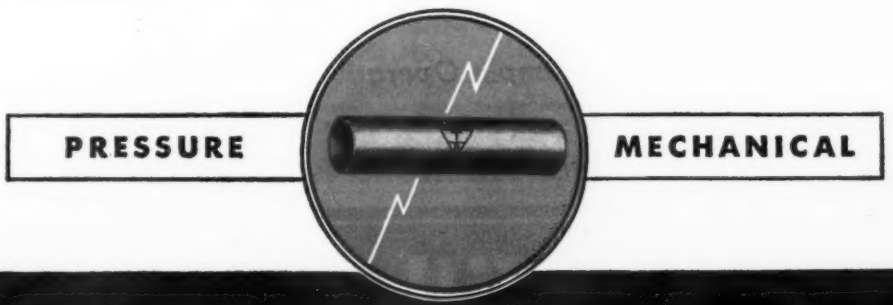
MECHANICAL METHODS—*threaded joints, riveted joints, drive screws, tapped plugs, and screws, slot and plate, friction clutch, telescoped joints, and patented rivets, screws and bolts.*

WELDING METHODS—*Oxy-acetylene welding, arc welding, atomic hydrogen arc welding, brazing, soldering, and electric resistance welding of various types.*

The electric resistance welding operation is the most important step in the manufacture of Talon's Electric Welded Steel Tubing.

As the tubing moves into position, the welding unit automatically adjusts itself up or down as necessary, and the proper amount of current is introduced. Side roll pressure brings the heated edges together at the instant the current takes hold to form a solid, welded joint. The planer, at the left in the photograph, removes the flash (excess metal) left by the welding operation.

No extra metal is added and the weld becomes a complete union, as strong as the edges and with the same strength and physical characteristics as the steel from which it is made. Subsequent heat treating gives a uniform, homogeneous structure in the weld.



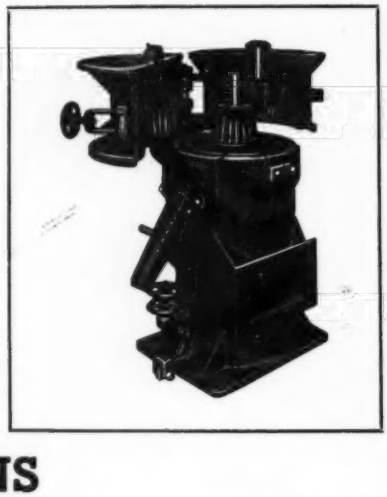
TALON . . INC.

STEEL TUBE DIVISION — OIL CITY, PENNA.

Regardless of Plant Size

IT PAYS TO SAMPLE COAL THE "STURTEVANT WAY"

Large coal buyers have sampled coal for years the automatic "STURTEVANT WAY" because it pays them. The same opportunities to make savings, conserve manpower and assure maximum operating efficiency and economy are open to operators of smaller plants. Regardless of the amount of coal purchased, its cost represents a high percentage of total operating expense. This expense can be reduced when coal is purchased on a strict B.T.U. basis from data furnished by accurate, automatic sampling.



A FEW REASONS

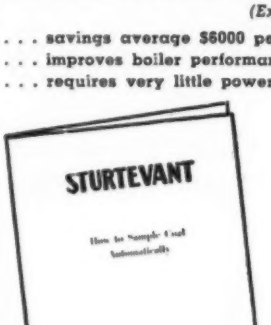
why the STURTEVANT WAY pays for itself

- ...accurate, representative samples are assured.
- ...makes possible the buying of coal on the basis of heat value and avoids paying for impurities and non-combustible materials.
- ...saves manpower as compared with hand sampling.
- ...saves time and labor and fuel.
- ...avoids misunderstanding with coal suppliers.
- ...makes possible adjustment of plant to suit coal from whatever source.
- ...provides a means for quickly and accurately evaluating coal as it is received and checking it against specifications.
- ...pays back the cost of laboratory service by providing representative and correct samples for analysis.
- ...eliminates the human element and inaccuracies which attend hand preparation of samples.

ADVANTAGES CONFIRMED BY USER EXPERIENCE

(Excerpts from reports of users)

. . . savings average $6000 per 100,000 tons over non-sampling.
. . . improves boiler performance—reduces maintenance.
. . . requires very little power to operate. (3 HP)



. . . a savings of 4 tons daily by testing 800 tons daily.
. . . more samples handled by the automatic method and representative of the shipment as a whole.
. . . crushing and sampling time so shortened that evaporation of moisture during preparation is practically eliminated.
. . . old hand method required entire day's time of one man whereas the Sturtevant way requires only a few minutes to run a 1000-pound sample.

Easy, Simple Operation

Coal is fed into hopper, reduced, mixed and discharged in 5, 10, or 15% samples with an elimination of 32 of the 34 operations required by hand sampling.

SEND FOR BULLETIN NO. 85

Sturtevant Mill Co.

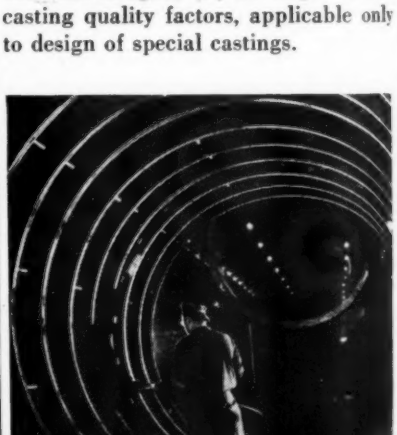
103 Clayton St., Dorchester, Boston, Mass.

of Lockheed Aircraft Corp, for "The Effect of Welding Spacing on the Strength of Spot-Welded Joints," Oct, 1942, *Welding Journal*. Honorable mention: F B Hensel, metallurgical consultant; E I Larsen, research engineer; E F Holt, senior research engineer, all of P R Mallory & Co for "Refrigerant-Cooled Spot Welding Electrodes," Dec, 1942, *Welding Journal*.

American Standard Code for Pressure Piping. Two subcommittees are being appointed under Sectional Committee on Code for Pressure Piping, B31:

(1) Subcommittee to formulate requirements for instrument piping, which at present are not sufficiently complete to provide adequate assurance of safety. For this assignment members will be selected from subcommittees that developed each code section representing the several types of piping, together with representatives of interested manufacturers.

(2) Subcommittee to develop quality factors for castings and working stresses for steel castings, forgings, plate and bars. Members are being selected, in accordance with recommendation by Joint Conference Committee on Piping Codes and Standards, endorsed by Subcommittee on Scope and Intent, to: (a) Formulate working stresses for steel castings, forgings, plate and bars for designing special fittings—not intended, however, for application to existing standard designs; (b) develop rules for casting quality factors, applicable only to design of special castings.



Steel Rings for Our Ships

Almost 10 ft diameter, these 9-ton circular steel frames, one of which a workman is smoothing off at Westinghouse Electric & Mfg Co works, will house 3300-hp electric motors on some of America's finest warships. Triple rings joined by cross bars make up the frames.

IS YOUR POWER SYSTEM OVERLOADED?

Do You Want More Capacity . . . Quickly . . . Inexpensively?

CAPACITOR PLUG mounted on BUStribution DUCT (handle on plug cover permits operation from floor).

Capacitor Plugs help in these ways!

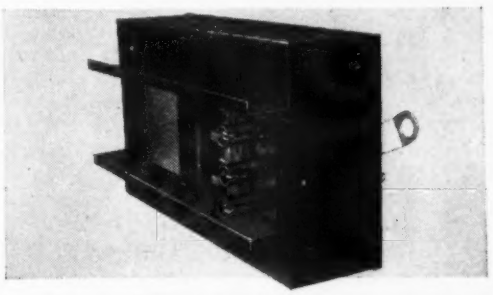
1. Inserted in any of the plug-in openings of your BUStribution DUCT, BullDog Capacitor Plugs increase the capacity of your electrical system by reducing the reactive KVA, thus ensuring lower operating temperatures and preventing needless fuse blows and production shutdowns.
2. They permit installation of Capacitors at the nearest point to your motors. As the load center shifts, the plug-in Capacitors can be shifted with it.
3. They represent a *decentralized,* and consequently more flexible, arrangement of Capacitors. Even if a unit should fail, the power factor correction of the entire system would not be affected, as it would with *centralized* banks of Capacitors.
4. They make possible the strategic location of Capacitors at the points in the system where poor power factor occurs, and this improves conditions for the rest of the equipment all the way back from the motors, through the bus duct, through the secondary switchboard, to the transformers.
5. Capacitor Plugs not only improve your power factor, but save valuable space and critical materials such as copper and steel . . . to say nothing of man-hours and production saved because of fewer blown fuses and greater operating efficiency.

BullDog field engineers are as close as your telephone for complete details . . . or write us direct.

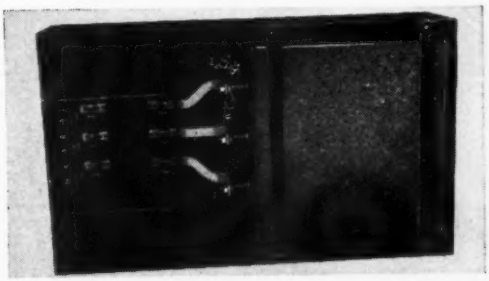
FOR A BRIGHT FUTURE BUY MORE WAR BONDS

New BullDog Capacitor Plug

You don't have to worry about space or supporting means for these Capacitors. Just plug them into the BUStribution Duct. It's as quick and easy as that! Rated from 1 to 15 KVA, complete with fusible switch or circuit breaker in one compact handy Plug for 230V or 460V 60 cycle.



Rear view of Plug showing bus contact fingers for plugging into openings along bus duct runs.



Capacitor Plug with front cover removed, exposing fusible disconnect switch and capacitor unit.

BULLDOG

ELECTRIC PRODUCTS CO.

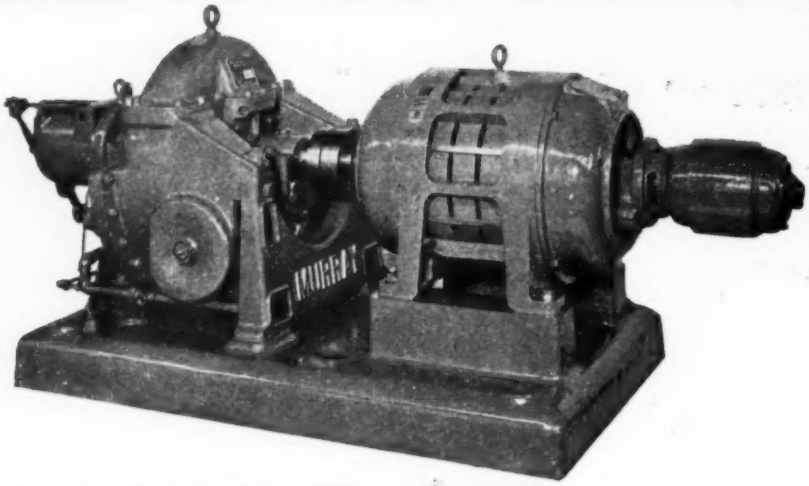
Box 177, R. Pk. Annex, Detroit 32, Michigan

BullDog Electric Products of Canada, Ltd., Toronto, Ontario

Field Engineering Offices in All Principal Cities

MANUFACTURERS OF a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Circuit Breakers and BUStribution SYSTEMS.

ADAPTABLE *to a variety of drives*

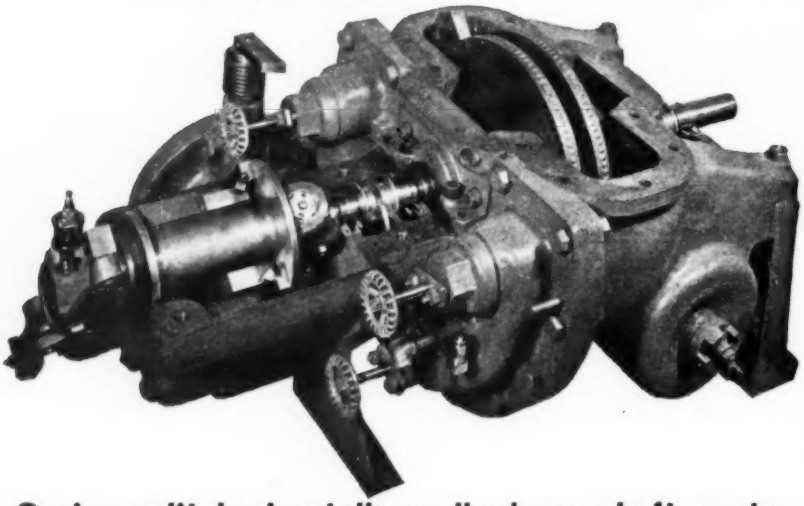


MURRAY

TYPE "U"

Mechanical Drive Turbines

• View shows Type "U" Turbine directly connected to a 20 K. W. Alternating Current Generator operating at 1800 r. p. m. The unit is installed in a large oil refinery in Venezuela where the turbine supplies exhaust steam for process requirements.



Casing split horizontally well above shaft center line to make possible

- Longer steam ring allowing considerably more nozzle area and larger steam inlet size, thereby increasing the maximum horsepower developed by a particular frame.
- Larger exhaust opening which permits of greater horsepower and improved efficiency, particularly for condensing operation.
- Additional hand valves for nozzle control. (Note that view shows three hand valves on our smallest frame, whereas the usual small conventional turbine has room for only one.)

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

CURRENT ARMY-NAVY AWARDS

Army-Navy "E" awards given to Blackhawk Mfg Co and Plant Rubber & Asbestos Works.

A white renewal star added to Army-Navy "E" pennant of Sarco Co. **Second white renewal star** awarded to Phelps Dodge Copper Products Corp, Habirshaw cable & wire div. **Third renewal star** on pennant of General Motors Corp, Cleveland diesel engine div.

Maritime "M" pennant awarded to Phelps Dodge Copper Products Corp, Los Angeles plant.

For Electrical Buses

Capable substitute for war-scarce copper and aluminum electrical buses is **wrought iron** whose suitability for **electrical buses** is shown in installations of Bonneville Power Adm, in Washington. J A Gerber, assistant engineer, stressed its following qualifications:

1. At 115 kv and 230 kv, buses are well within carrying capacity of wrought-iron pipe, largest required being 4-in. IPS standard weight. Current carrying capacity may be further increased by slotting pipe along its length to break the ferrous loop, and by coating pipe with dull black paint to increase heat emissivity.
2. Wrought iron has a high modulus of elasticity, permitting long spans, particularly with ice and wind loading, thus saving on insulators, fittings and supports.
3. It has good corrosion-resisting properties. Paint gives added protection and is easily applied.
4. Welding is an easy, quick and economical way of joining the pipe into any desired bus arrangement. All clamp fittings are eliminated since welding produces joints with high electrical efficiency and permanency.
5. It expands less than copper or aluminum, requiring fewer expansion joints.
6. It costs less than aluminum or copper pipe of same size.
7. Welded buses reduce corona formation.

Wrought-iron buses at Bonneville were finished by first removing protective asphalt varnish from the pipe and cleaning with an abrasive, then applying a coat of synthetic red lead and two coats of aluminum paint.

Free Enterprise At Work

What's Behind the Trade Mark?
QUALITY
TRADE MARK
YOUNGSTOWN
SERVICE

THE middle and late '20's were a period of steady growth for The Youngstown Sheet and Tube Company. Following the acquisition of two other steel companies early in 1923, sound policy effected consolidation of the three properties into one strong, unified organization, well diversified in products.

Gradual improvement in general conditions, especially in building construction and the oil industry, permitted Youngstown to prosper. Sales held steady. Selling prices were low, but earnings were good . . . the fruits of farsighted plant improvements and advanced production methods.

It was fortunate, in view of today's tremendous war needs, that freedom of enterprise permitted American manufacturers to earn good profits in the 1920's and to invest those profits in further strengthening themselves. Youngstown's property investment rose from $159,000,000 in 1923 to $223,000,000 in 1929. In those seven years, over $100,000,000 was invested in plant additions and improvements . . . to make steel better, faster. No less important, continuing good earnings permitted the company to dispose of $37,000,000 worth of obsolete, and worn out equipment.

Youngstown has flourished under the system of free enterprise. As a result, it is now in a position to help sustain America in its fight for existence and will serve effectively in meeting the nation's steel needs tomorrow.

Historical Series - - - No. 10

TAPPING HEAT OF ELECTRIC FURNACE STEEL

YOUNGSTOWN
THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN, OHIO
Manufacturers of
CARBON - ALLOY AND YOLOY STEELS
Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate
Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels

Put "AMBEST" to a long life test on any tough job

EUREKA

This UNIVERSAL packing — of long, pliable, anti-friction metallic alloy strands—assures low cost, long life packing protection and easy application on any rod in good condition. "AMBEST"—available for all pressures and temperatures up to 550° F. — is recommended for pumps, compressors, engines, throttles and valve stems. All needs are supplied by one packing when you use "AMBEST."

Write for Working Sample
Send for 36 page catalog.

EUREKA PACKING CO., 294-296 46th St., BROOKLYN 20, N. Y.

Short of Help?

ROTO Tube Cleaners Provide One-man Operation

ROTO Model 135 air-driven motor with swing-frame head and air valve for one-man operation.

Wherever labor shortages exist, Roto Tube Cleaners, equipped for one-man operation, are indispensable. By giving the operator full control of air, you can not only release his helper for other work, but actually enable him to do a better, faster job. There is no time lost signalling a helper at a remote point to turn air on and off, saving many hours on the entire job. Whatever your tube cleaning requirements are, Roto can fill them satisfactorily.

The ROTO Company

145 Sussex Ave. Newark 1, N. J.

OBITUARIES

Erle F Whitney, manager of General Electric's East Central district, died in Cleveland on Dec 12 after an illness of several months.

David B Piersen, 63, chairman of Board of Directors of Stephens-Adamson Mfg Co, died Nov 29 after a heart attack.

Frank J Reynolds, engineer of Hartford Electric Light Co from 1917 until his retirement in 1942, died suddenly at Rockymount, N. C., on Dec 19. He was employed by Thomson-Houston and General Electric in equipment installation of steam-electric plants.

William G Irwin, chairman, Board of Directors, Cummins Engine Co, died suddenly Dec 14 at the age of 77. He was one of the key figures in the development of this country's diesel-engine industry.

M T Mortensen, staff member of Detroit sales office of American Foundry Equipment Co, died from a heart attack.

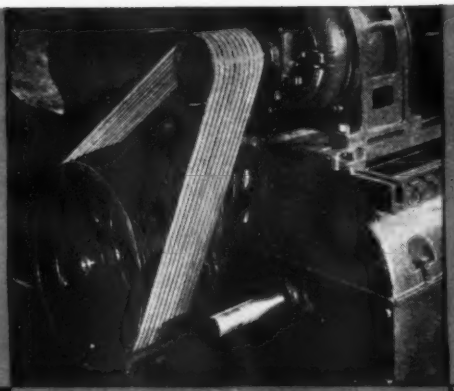
APPOINTMENTS

Timken Roller Bearing Co announces the following appointments: **Paul Reeves** as advertising manager, **Ralph L Wilson** as chief metallurgical engineer, **Donald S Klippert** as assistant general sales manager of steel and tube div and **Robert P Donnell** as Cleveland district manager. **The Peninsular Steel Co** will expand their activity in Ohio for distribution of Timken graphitic tool steels. The added territory will include Dayton and Cincinnati, formerly covered by Quality Steels, Inc, and Frederick Steel Co.

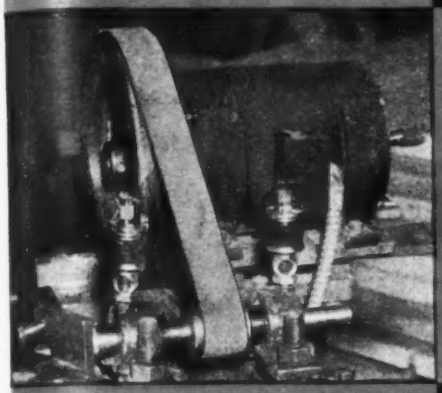
Samuel D Lunt has been elected a member of the board of directors of **Wickwire Spencer Steel Co,** replacing Charles G Terry. At a meeting of **American Wire Fabrics Corp, L D Granger** was elected vice-president; **George H Creveling,** treasurer; and **Franklin Berwin,** secretary. **E M Allen** announces his retirement as president of **The Mathieson Alkali Works** and election of **G W Dolan** as his successor. Mr. Allen will continue to hold office as chairman of board of directors.

W M Stearns, manager, trade relations and special contracts, retires after 39 years with **General Electric.** Mr Stearns will be succeeded by his assistant, **W A Sredenschek.** Membership of the new GE standards policy committee consists of: **L F Adams,** head; **H W Robb,** secretary; **P L Alger** and **T D Foy,** engineering assistants to works managers; general superintendent of each works; and a representative of each of appliance and merchandise, electronics, and lamp

A Gilmer BELT FOR EVERY DRIVE

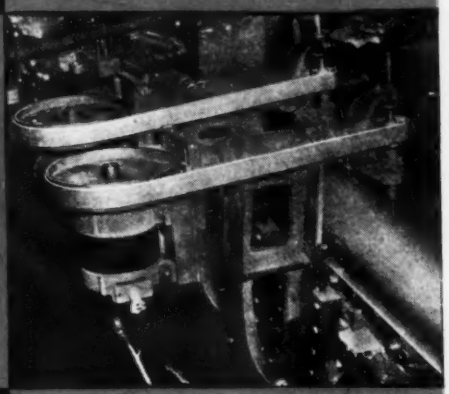


◀ *(Left)* **GILMER V-BELTS:** Space-saving, silent, shock-absorbing belts, built to lock in the grooves with a non-slip grip. Made in standard and special sizes.

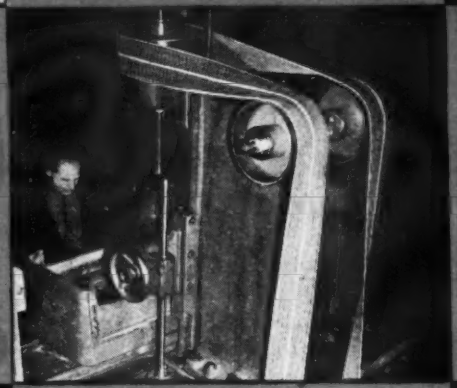


(Right) **GILMER HEVALOID ENDLESS BELTS:** ▶ Made under the Hevaloid patent with Neoprene compound that provides high coefficient of friction. For precision work at top speed of 9000 f.p.m. Resists oil, heat, stretch and slippage.

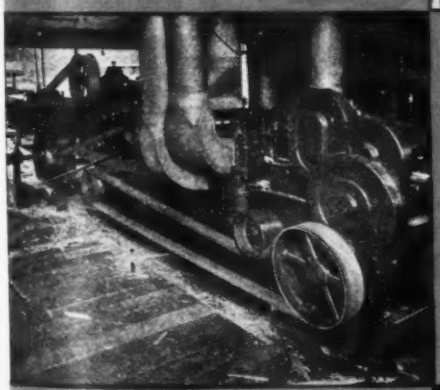
◀ *(Left)* **GILMER SPEEDAGE BELTS:** Very light, lapless, flat, fabric belts for high speeds to 10,000 f.p.m. and over. Assures chatterfree production.



(Right) **GILMER KABLE KORD BELTS:** ▶ Rubber Fabric and tough continuous cord construction give you a contactor and power belt in one. Exceptional grip and strength combine in these flat belts with low-stretch, small slippage and extra tensile strength.

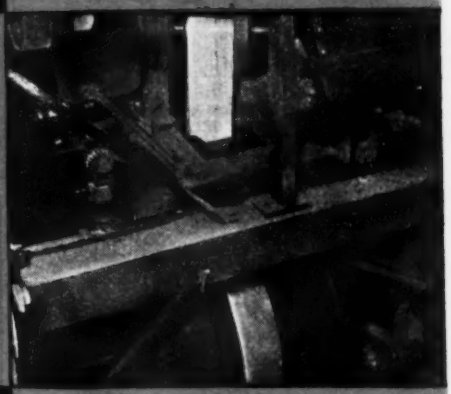


Gilmer also makes Round Endless Belts, Special Endless Belts, and Belts for Textile and other specialized industries. Write for the Gilmer Belt Catalogues . . . Free for the asking.



(Right) **GILMER RHO ENDLESS BELTS:** ▶ Flat endless belts, rubber-fabric, jacket-enclosed. Sturdy, light and very flexible, for speeds under 7400 f.p.m.

◀ *(Left)* **GILMER ENDLESS PLANER BELTS:** A typical special purpose belt of endless cord construction for planer and gang-saw drives.



USE WHAT YOU LOSE

Gilmer BELTS

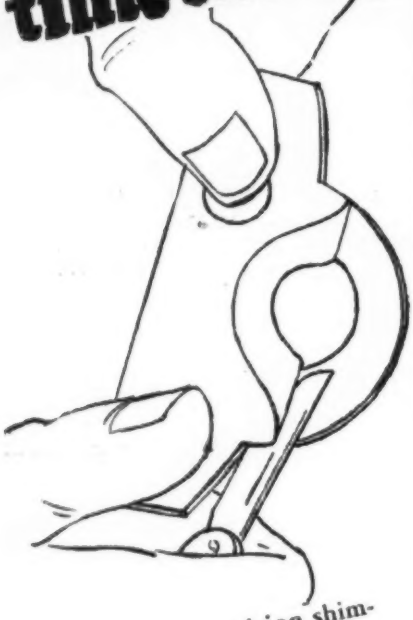
L. H. GILMER COMPANY

Tacony, Philadelphia 35, Pa.

The Oldest Firm of Rubber Fabric Belt Specialists

The Gilmer Engineering Staff has planned a National Power Recovery Plan . . . a FREE war-time service to industry . . . approved by the WPB . . . to save power in the following services: Steam, Gas, Electricity, Mechanical Transmission, Boilers, Compressed Air, Refrigeration and Prime Movers. Write for your FREE copy today.

designed for time saving



Quick-precision shimming with Laminum often cuts assembly time 20 to 30%. Is introduced without fuss ... also eases shop, maintenance and service routine.

Shims cut to your specifications. Stock shim materials obtainable from your dealer. Write us for further information and shim application chart.

Laminated Shim Company
Incorporated
61 Union Street • Glenbrook, Conn.

LAMINUM

THE SOLID SHIM THAT peels FOR ADJUSTMENT

2044

departments. Committee will be responsible for development and maintenance of design engineering, manufacturing standards and practices.

General Motors announces that their Grand Rapids plant, now operated by Saginaw steering gear div, will be a permanent postwar industry. It will be known as the diesel equipment div and will manufacture injectors for diesel engines. **C F Runchey,** manager, Grand Rapids plant, will become general manager of new div. **C W Truxell,** of Detroit diesel engine div engineering staff, will be appointed chief engineer.

R C McNelly has been appointed to direct advertising of **Ansul Chemical Co** and its subsidiary, **duGas Engineering Corp. Allen B Du Mont Laboratories** announces the appointment of **David Gross** as sales director of materials test div. **Carl Bachmann,** frequent contributor to POWER, has resigned his position with American Hotel Corp to accept position of district engineer for **Montgomery Ward Co,** Detroit. **Link-Belt Co** announces that **E L Berry** and **Richard F Bergmann** have been elected vice-presidents, with headquarters at company's general offices, Chicago. **John E Martin** has been appointed manager of **Link-Belt Ordnance Co,** with headquarters at plant.

B F Stauffer was elected president and general manager of **American Anode, Inc,** succeeding Raymond W Albright. **Edward H Fitch** has been named manager of combined automotive, aviation and government sales div and **H E Van Petten** has been appointed manager of advertising of **The B F Goodrich Co. Archie Chandler,** vice-president, **American Pulley Co,** Philadelphia, has an-

YOU DON'T *HAVE* TO BE CRAZY— TO TAKE CHANCES...

...BUT IT HELPS!

NATIONAL SAFETY COUNCIL

Turkeys, 44,000 lb. at Once, Quick-frozen with FRICK Refrigeration

U. S. soldiers, sailors, marines, and aviators use quick-frozen foods by the millions of pounds daily.

That's a common occurrence in the big packing plant of the Jerpe Commission Co., C. A. Swanson and Sons, at Omaha, Nebraska.

Here three large Frick Refrigerating Machines hold temperatures in the freezing tunnel far below zero F. Overhead fans maintain a blast of very cold air over the poultry or other foods. (Meat, vegetables, fruit, or dairy products can all be handled with equal facility.)

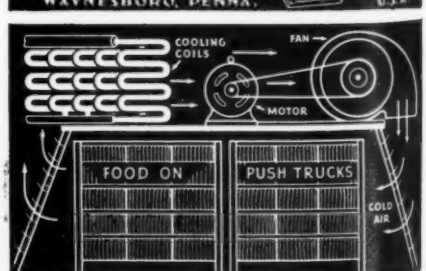
Engineering tests show that when the air blast is kept cold enough, it can absorb but little moisture from the foods. Turkeys and all other poultry come out with 99-66/100 per cent of their original weight.

Millions of pounds of fresh foods are being quick-frozen every day with Frick Refrigeration. It's the ultimate where both quality and large volume must be maintained.

DEPENDABLE REFRIGERATION SINCE 1882

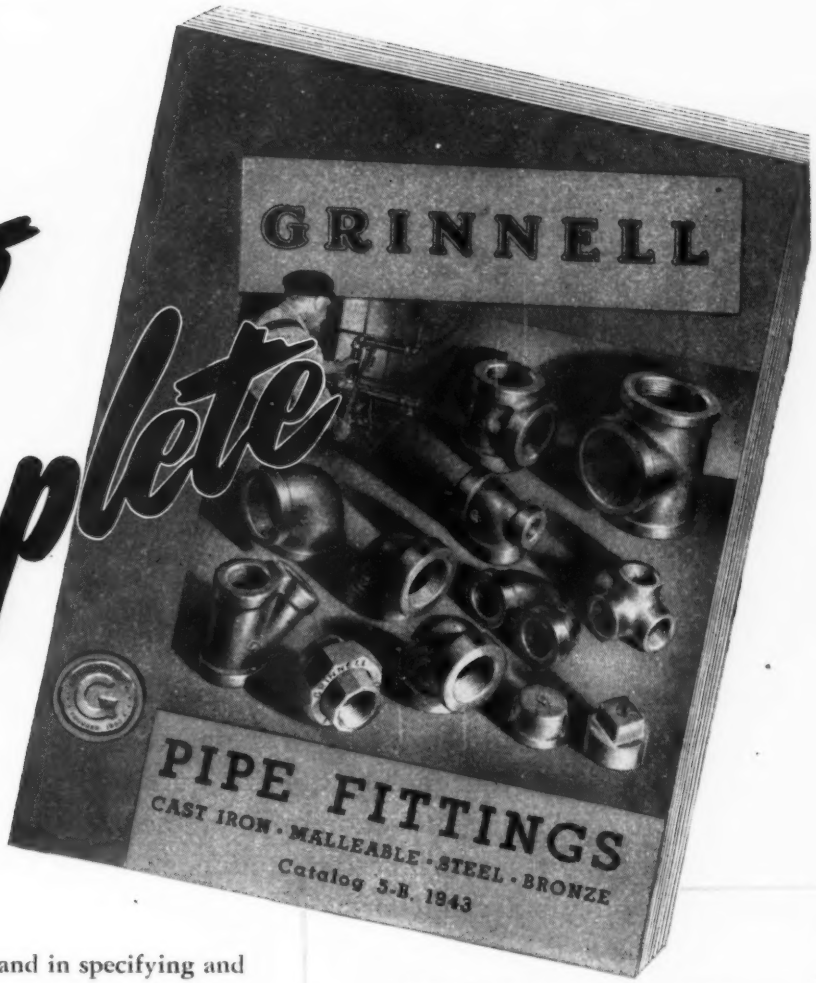
FRICK CO.

WAYNESBORO, PENNA., U.S.A.



SECTION VIEW OF FRICK-FREEZING SYSTEM

It's New
It's Complete



To help you with your piping layouts and in specifying and ordering pipe fittings for any requirement, Grinnell offers this new, complete catalog.

It includes detailed information, list prices, materials, dimensions and service pressures for Grinnell's complete line of cast iron, malleable iron, steel and bronze fittings.

For prompt service in procuring a copy, write or phone your nearby Grinnell office listed below.

GRINNELL

WHENEVER **PIPING** IS INVOLVED

TYPES OF FITTINGS LISTED

			w.s.p.
CAST IRON,			
	Screwed —	Standard	125 lbs.
		Extra Heavy	250 lbs.
		Sprinkler	175 lbs.
		Drainage	
	Flanged —	Standard	175 lbs.
		Extra Heavy	250 lbs.
MALLEABLE IRON,			
	Screwed —	Standard	150 lbs.
		Extra Heavy	300 lbs.
		AAR	300 lbs.
		Plain	
		Railing	
STEEL,			
	Screwed —	Wrought (Nipples & Cplgs.)	
		Cast —	1000 to 2000 lbs.
		Forged —	2000 to 6000 lbs.
		(also flanges)	
	Flanged —	Cast	150 to 1500 lbs.
BRONZE,			
	Screwed —	Standard	125 lbs.
		Extra Heavy	250 lbs.

MISCELLANEOUS SUPPLIES

GRINNELL COMPANY, Inc.
Executive Offices, Providence, Rhode Island

ATLANTA 2, GA.
240 North Highland Avenue, N. E.

CHARLOTTE 1, N. C.
1431 West Morehead Street

CHICAGO 9, ILL.
4425 South Western Avenue

CLEVELAND 14, OHIO
1294-6 East 55th Street

HOUSTON 1, TEXAS
1121 Rothwell Street

MINNEAPOLIS 15, MINN.
240 Seventh Avenue, South

NEW YORK 17, N. Y.
347 Madison Avenue

PHILADELPHIA 34, PA.
Erie Avenue and D Street

PROVIDENCE 1, R. I.
260 West Exchange Street

ST. LOUIS 10, MO.
1140 Central Industrial Avenue

ST. PAUL, MINN.
194 West Fourth Street

WARREN, OHIO
Dana and Paige Avenue

LOS ANGELES 13, CALIF.
520 Mateo Street

OAKLAND 7, CALIF.
2230 Peralta Street

SAN FRANCISCO 7, CALIF.
601 Brannan Street, cor. Fifth

SEATTLE 1, WASH.
3101 Elliott Avenue, cor. Bay Street

Leather Belting Coming Up!

Behold a scene of vital interest to production men everywhere. For these steers will provide approximately 900 feet of four-inch single first quality Leather Belting . . . help meet the demand for the most efficient of all power transmission mediums. (Sure, the animals will yield swell sirloins too, but these days factory chiefs think first of plant output, personal intake second).

Leather Belting delivers more power at lower maintenance cost than any other material. It has no equal. Its inherent characteristics—greater gripping power, flexibility, tensile strength and longer life—enhanced by the modern techniques of the tanner, currier and belt manufacturer, make Leather Belting productively, economically preeminent. And even after years of service, it has a worthwhile salvage value.

Consult your own Leather Belt maker. In him you can place absolute reliance for the right answers to your transmission problems, whatever they may be.

WM. C. BROWN LEATHER CO.

Tanners & Manufacturers

1702-10 TULIP STREET **PHILADELPHIA, PA.**

Besides leather for flat and round belting, we manufacture pump, hydraulic, polishing, strap and harness leathers.

nounced his retirement from active sales management. Mr. Chandler will continue as vice-president, but will direct sales and service on West Coast. **Frank E Brown,** for 15 yr assistant sales manager, has been named to succeed Mr. Chandler as general sales manager.

Lemuel R Boulware has been appointed vice chairman, **War Production Board.** Mr. Boulware succeeds Hiland G Batcheller. Vice-chairman **Donald D Davis** has been given charge of all WPB field operations, in addition to his present duties. **Dowsley Clark** has been named chief of news bureau, **Office of War Information,** succeeding Charles L Allen.

Bedaux Co announces that the facilities of its research and development bureau will be made available to educators and to technical and professional societies in fields of industrial management, business administration and related activities. Formerly, the bureau, which compiles data and develops new ideas on all phases of production management, served only the company's clients. Reorganized bureau is now headed by **F A Mattka,** who has been with the organization since 1936.

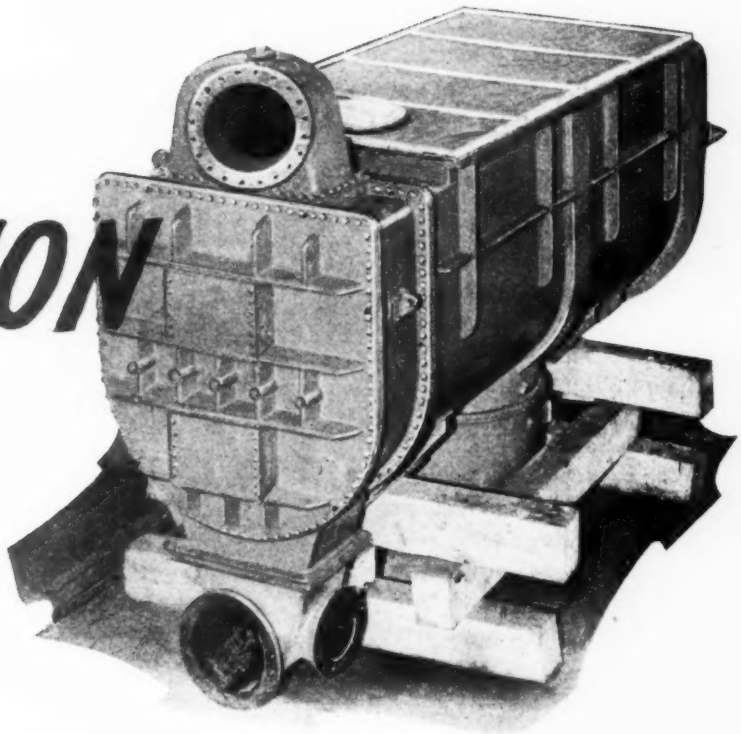
Kieley & Mueller, Inc, has appointed **C H Stone & Co** sales representative in New England area. **The Bardco Mfg & Sales Co** and **Snow irrigation supply div** of Bardco Co have announced completion of arrangements with **Frazar & Hansen** to handle their export business. **Titeflex Metal Hose Co** will hereafter be known as **Titeflex, Inc. A-Jacks Automatic Regulator Co** has bought manufacturing and service rights of the steam-damper control, over-fire control and cam-valve control from **National Regulator Co.**

Wickwire Spencer Steel Co names **Robert T Dunlap** general superintendent of Buffalo Works. After 45 years service with **General Electric, Walter L Harraden,** one of the company's street-lighting pioneers, has retired. **B F Goodrich Co** has appointed **Wallace F Bowman** departmental auditor in Akron. **C J Stegemerten,** staff supervisor, industrial methods engrg, **Westinghouse Electric & Mfg Co,** has been appointed expert consultant to the **Secretary of War. The Engineer Co** announces that **George J Zanke** is district sales manager, in Chicago, and W D Taulman and Associates representatives in the Southeast.

Crosley Corp announces that **S D Mahan** has been appointed director of

CONDENSERS BY HTP

PLAN



PRODUCTION

PERFORMANCE

Condensers **Feed Water Heaters** **Fuel Oil Heaters**
Steam Jet Air Ejectors **Evaporators** **Jacket Water Coolers**
Lube Oil Coolers

HEAT TRANSFER PRODUCTS, INC.

ENGINEERING and SALES OFFICES — 90 WEST STREET, NEW YORK 6, N. Y.
PACIFIC COAST OFFICE — 260 CALIFORNIA STREET, SAN FRANCISCO
PLANTS—CARBONDALE, PA. • POTTSTOWN, PA. • HONESDALE, PA.

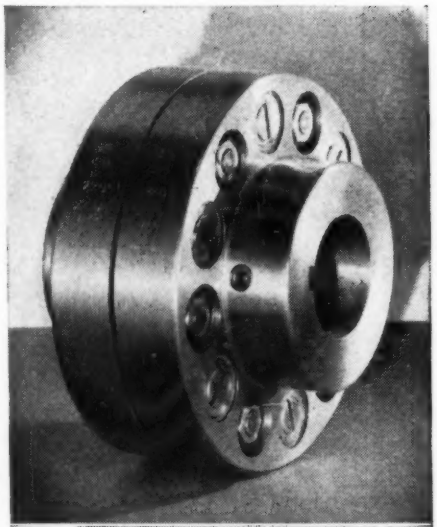
DESIGNERS, ENGINEERS and MANUFACTURERS of ALL TYPES of HEAT EXCHANGERS

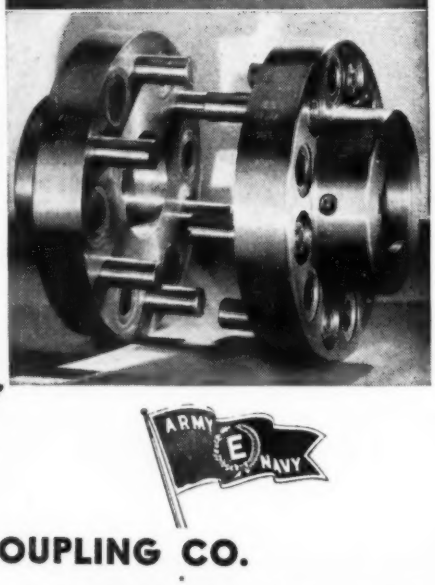
Try This for 10 Seconds

Just take a couple of pencils right now and try to hold them in perfect alignment without touching each other while you count 10.

Remember that you are making this 10 second test with pencils weighing a fraction of an ounce. At the same time, remember that all the horsepower goes through the coupling connecting heavy machines running at high speed hour after hour.

Ajax Flexible Couplings have been doing this job for over 20 years. They do it without lubrication because of their rubber bushed, graphited-bronze bearings and interlocking drive studs. Write for the facts on Ajax Flexible Couplings.





AJAX

ARMY E NAVY

FLEXIBLE COUPLING CO.

Incorporated 1920

WESTFIELD, N.Y.

advertising and public relations of manufacturing div. **Joshua Hendy Iron Works,** Crocker-Wheeler electric div, announces appointment of **R D Ulrey** as manager, Los Angeles office. **James H Jewell** has been appointed assistant manager of industry dept of **Westinghouse Electric & Mfg Co.** Mr. Jewell, manager, agency and specialties dept since 1940, will continue to head that div. **James A Dwyer** has been appointed general manager of sales and branches of **Crane Co,** with headquarters in Chicago. **James Dalton Cunningham** was recently elected to board of directors of **Allis-Chalmers Mfg Co.** Mr. Cunningham succeeds Charles W Cox.

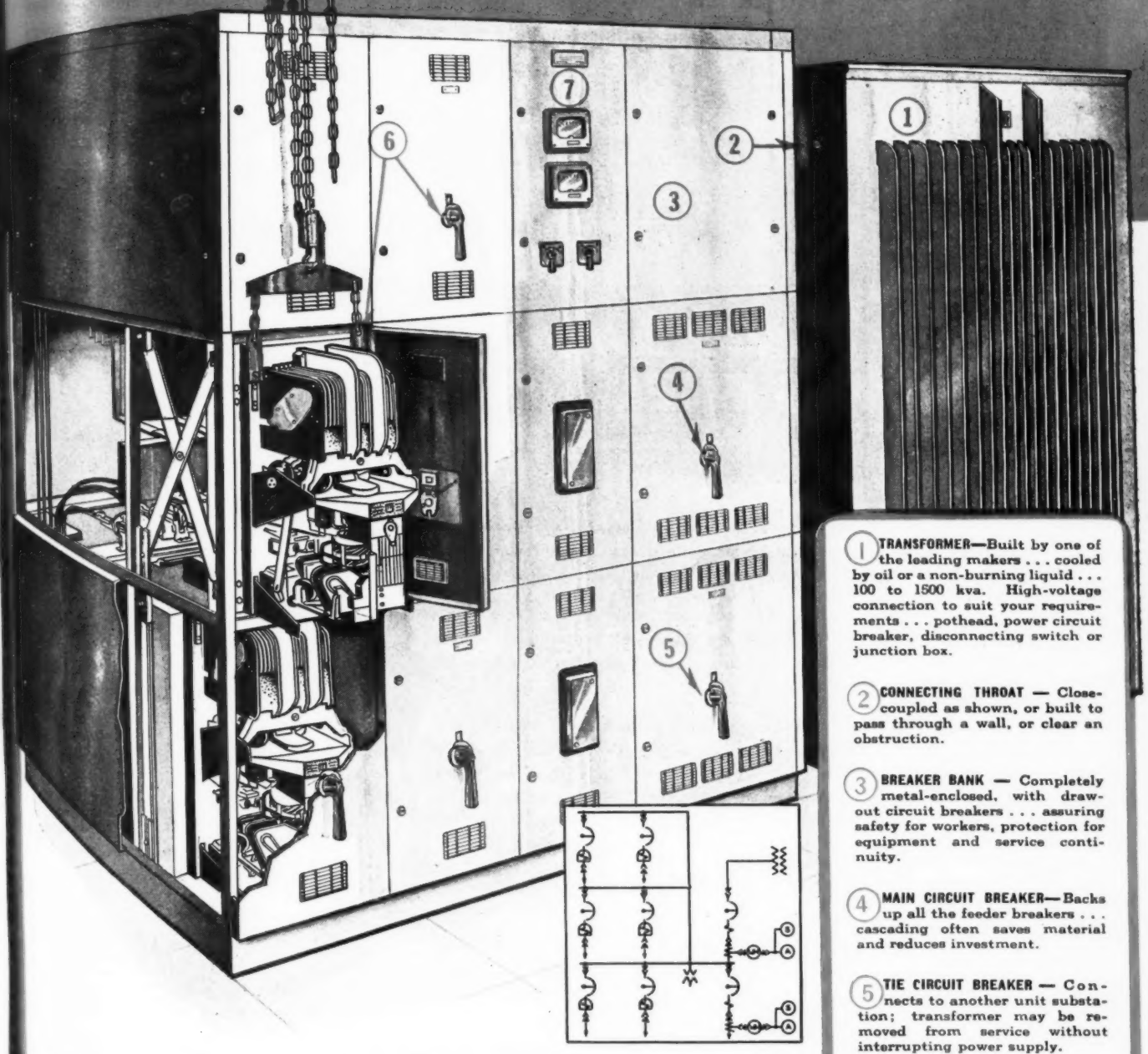
H W Lange has been appointed sales manager, fire division, **Cardox Corp.** Previously Mr Lange was chief engineer of the division. **Herbert Markle**, division manager Bluefield division, **Appalachian Electric Power Co.,** has retired; his assistant, **G L Furr,** succeeds him. Other changes include promotion of **M C Funk,** vice-president and general manager, Kentucky and West Virginia Power Co, to the same position in the Appalachian system. **J W Hancock,** retiring division manager, Roanoke and Lynchburg, Va. division of Appalachian, will be succeeded by **W J Whitefield. Edw H Whittemore,** formerly sales engineer, Westinghouse Electric Elevator Co has been appointed **fire marshal of Mass. Peter Stori** is now manager of the combustion equipment div, **Enterprise Engine & Foundry Co.**

Richard N Mathews is manager of the San Francisco factory branch office opened by **Ross Heater & Mfg Co, Inc.** Elected to the board of trustees of **Illinois Institute of Technology** are **David T Siegel,** pres, Ohmite Mfg Co; **Whipple Jacobs,** pres, Belden Mfg Co; **Claude A Knuepfer,** pres, General Engineering Works; **T Albert Potter,** pres, Elgin Natl Watch Co; **Harold B Smith,** pres, Illinois Tool Works. **Heat Transfer Products, Inc,** appoint **E A Bertram** general manager; they also appoint **Harry W Parsons Engrg Co** representatives on the West Coast. **Walter J Ewbank,** B S, M S, has been appointed chief engineer, **Briggs Clarifier Co.**

American Foundry Equipment Co names **Otto E. Zahn** asst works manager, with supervision over manufacturing. **Frederick J Lupke, Jr,** is manager of the new Detroit factory branch office of **Ross Heater & Mfg Co, Inc.** A new organization, **Wade Mfg Co, Division of Woodruff & Edwards, Inc.,** results from the joining of forces of two firms as a

I-T-E DRAWOUT SWITCHGEAR

Features You Want in Unit Substations



(1) **TRANSFORMER**—Built by one of the leading makers . . . cooled by oil or a non-burning liquid . . . 100 to 1500 kva. High-voltage connection to suit your requirements . . . pothead, power circuit breaker, disconnecting switch or junction box.

(2) **CONNECTING THROAT** — Close-coupled as shown, or built to pass through a wall, or clear an obstruction.

(3) **BREAKER BANK** — Completely metal-enclosed, with drawout circuit breakers . . . assuring safety for workers, protection for equipment and service continuity.

(4) **MAIN CIRCUIT BREAKER**—Backs up all the feeder breakers . . . cascading often saves material and reduces investment.

(5) **TIE CIRCUIT BREAKER** — Connects to another unit substation; transformer may be removed from service without interrupting power supply.

(6) **FEEDER CIRCUIT BREAKERS**—Drawout type . . . spare breaker may be substituted during periodic inspections.

(7) **BUS TRANSITION FRAME** — Provides for branching buses . . . instruments may be mounted on doors.

Advantages of Unit Substations have led to rapid adoption and will lead to much wider use—saving in cable copper, reducing voltage drop by employing short feeders, saving in space with compact arrangement of indoor transformers and breaker banks, quick installation and equally simple removal to a new location.

Design and construction of the unit are important in providing such advantages in fullest measure.

The features of design and construction identified on this page are but a few that I-T-E engineers will gladly go over with you.

Representatives in Principal Cities

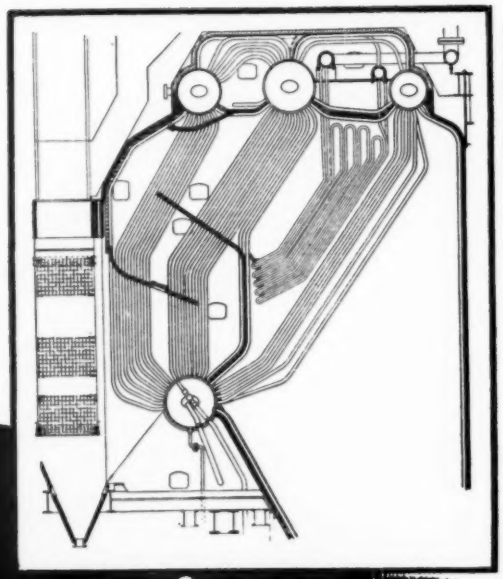
I-T-E

AIR SWITCHGEAR

IMMERSED IN AIR — ENCASED IN STEEL

The Army-Navy "E" for Production Excellence

CIRCUIT BREAKER CO., PHILADELPHIA 30, PA.



Streamlining SAVES FUEL

MODERN methods of baffling boilers have reduced flue gas temperatures and draft losses, with a resulting increase in efficiency, capacity, economy of operation and ultimate saving of fuel.

Enco Streamline Baffles are built gas tight and at any angle across the tubes, or interbank spaces, in all water tube boilers. The construction provides for easy removal of tubes and is a life time job.

The long sweeping curves promote the smooth rapid flow of gases over practically every square foot of the heating surface — gas passes are tapered in correct proportion to the contraction of the gas as it cools to maintain gas velocity. Bottle necks, dead gas spaces and soot pockets are eliminated with resulting better heat-transfer and minimum draft-loss.

Flexibility in design and construction permits baffles to be placed in the most effective position instead of a convenient location for easy installation.

Since boilers differ as to size and location of superheaters, number of drums, location of damper, nature of fuel, use of arches, water walls, etc., the design of an Enco baffle for each boiler is an engineering study which requires, and gets, individual study.

FREE BOILER BAFFLES

● *A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 44 It's free.*

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

supply source for plumbing drains, marine fittings, etc. **J F Hallowell** has charge of sales of **McClave Co** stokers and grates in the Pittsburgh area; **The Conditioning Co, Inc** has charge of them in northern New Jersey.

The Carborundum Co announces several changes: **E R Baxter** is assistant to Chas Knupfer, vice-president in charge of sales; **John F Claydon** is now district sales manager in Boston. He succeeds **Fred W Bonacker** who is assigned to special sales work in Niagara Falls. **A A Murfey** is now district sales manager in Cleveland.

Draft-Fan Erosion

(Continued from page 70)

crease pressure loss causes bad stratification of flyash, as well as spins and eddies in the gas flow. If volume control is normally by vanes in the fan inlet, more power will be required by partial closing of the dampers.

However, if changing motor or fan wheel is impracticable, damper linkages illustrated in Fig. 2 can be substituted so that damper leaves move oppositely in the relative positions shown. With this arrangement, the gas flow is substantially parallel to ductwork and erosion is minimized.

Links of this type do not provide for tight closure for fan inspection and repair. For this, fan isolation can be quickly accomplished by replacement of the original links while the system is still hot. After installation of dust collectors or other change that requires full fan capacity, the linkage of Fig. 2 becomes obsolete and the original arrangement is restored.

Where volume-control vanes are located in the fan inlet cone, omission of dust collectors means that, for a given volume handled, vanes must be closed considerably more than if the collectors were in place. This causes excessive wear on the parts of the vane assembly and concentration of flyash on only a small section of the fan-blade surface, with resultant shortening of wheel life.

Damper linkage of Fig. 3 is adjusted by turnbuckles to impose an added resistance to the system approximately equal to that of dust collectors. Then the control vanes will open to what might be considered their normal position. The damper leaves, as in Fig. 2, direct gas flow substantially parallel to the duct wall and minimum tendency for localized erosion is imposed.

Easy spreading

Now SEAL *both* OIL *and* WATER

NEW JOHN CRANE *Insoluble* PLASTIC LEAD SEAL *FOR Heavy duty*

PIPE-LINE, REFINERY, MARINE, POWER, CHEMICAL, AVIATION, INDUSTRIAL USES

Temperatures to 600° F. . . . Pressures to 4000 pounds per sq. in.

One "easy-spread" application and your sealing job is done—for sure, for years! John Crane new lead seal is plastic: will not set or seize nor harden under temperature extremes. Joints may be broken after years of service and remade without scraping. Protects threads, eliminates corrosion. Prevents scoring and galling. Adjusts to all clearances. May be applied to cork, paper, asbestos, copper, aluminum, lead, steel . . . John Crane Insoluble Plastic Lead Seal is a scientific laboratory formula made from pulverized metallic lead carried in a special vehicle: smooth, easy-spreading, fast-flowing. It is chemically pure: no red lead, clay filler or dope. An insoluble lubricant as well as a seal . . . Send for prices, sample and literature. Packed in 1, 3 and 5 pounds ready for use.

SERVICES: Oil, gasoline, kerosene, benzol, propane, butane, bottled gases, steam, water, hydrocarbons, aqueous solutions, ammonia, CO_2, toxic and inflammable gases, lutings in plugs.

EQUIPMENT: Threaded joints, flanges and gaskets, nuts, caps, valves, plug valve stems and seats, safety fuse plugs, screwed fittings, pumps, cylinder heads, boilers, compressors, stills, tanks, towers, gas stoves, etc., etc.

CRANE PACKING COMPANY, 1800 CUYLER AVENUE, CHICAGO

Branches: Baltimore, Boston, Buffalo, Cleveland, Dallas, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Tulsa

Crane Packing Co., Ltd., Hamilton, Ontario, Canada

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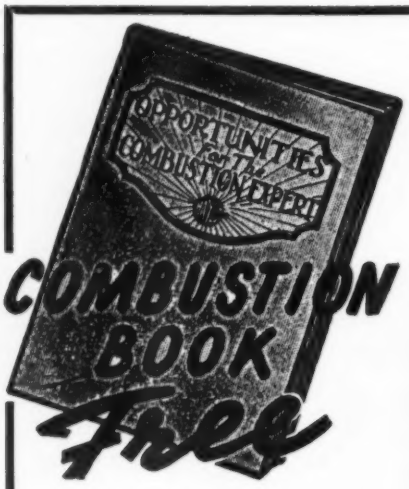
Extensively used by ✪ LEADING AIRPLANE BUILDERS



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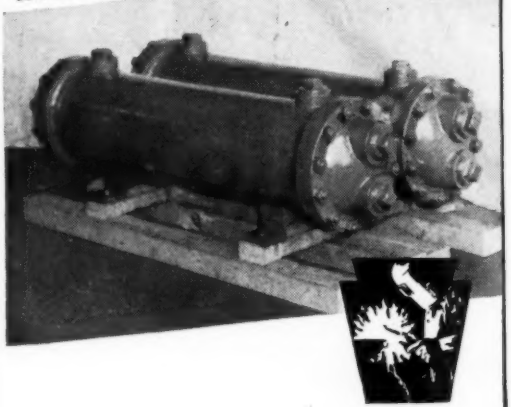
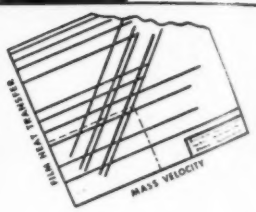
TO YOUR EXACT SPECIFICATIONS

Liquid to Liquid Exchanger for Synthetic Rubber Plant Stainless Tubes, Steel Shell 20" shell and 10' Tube length.

Above—Dephlegmating Condenser for Synthetic Rubber Plant.
Below—Small Jacket Water Heat Exchangers for Diesel Engines.





• **THERMAL DESIGN** by Downingtown includes calculation of optimum heat transfer rates and fluid flow paths, based upon continuous research, for heaters, coolers, condensers and some types of evaporators. Some recent unusual examples are:

Cooling complex mixed gases with water; condensing organic vapors (alcohols, solvents) with water; cooling methyl alcohol with boiling Freon; cooling diesel jacket water with crude oil in pipeline.

• **MECHANICAL DESIGN** draws on Downingtown's wide experience in metallurgical selection of materials plus strength and Code compliance calculations. Chrome, irons everdur, pure nickel and stainlesses including 18-8 SMO are fabricated regularly.

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SINCE 1913-FABRICATORS OF QUALTY STEEL & ALLOY PRESSURE VESSELS

THE COST OF LEAKS
SIZE OF OPENING
AIR 100 LBS. PRESSURE
STEAM 100 LBS. PRESSURE
WATER 40 LBS. PRESSURE
CU. FT. WASTED PER MONTH
COST AT 10c PER M
LBS. WASTED PER MONTH
COST AT 60c PER M
GAL. WASTED PER MONTH
3/8 9,979,200 $997.92 460,000 $276.00 692,400 $103.00
1/4 4,449,600 444.96 203,000 121.80 307,700 45.00
1/8 1,114,560 111.46 50,500 30.30 76,900 12.00
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TIGHT VALVES STOP LEAKS—SAVE MONEY
USE DEXTER VALVE RESEATING MACHINES

You can see a lot through a PINHOLE

POWER PLANT Executives, for example, can see the loss of thousands of pounds of steam, air or water in a valve leak no bigger than the average pinhole.

In terms of pounds and money, a little $\frac{1}{32}$ inch valve leak can pile up real losses, as shown on the card. Here are the figures taken from long-term tests, based on normal pressures.

Larger leaks produce losses in far greater proportion than on a basis of comparative size. For instance, a $\frac{3}{8}$ inch leak brings a loss of 460,000 lbs. of steam, normally costing $276.00 a month!

Reseat the Valve the Easy Dexter Way

Losses in steam, air, water — and DOLLARS, by leakage, are only the *first costs*. Shutdowns, replacements and high labor costs follow . . . *unless* you are equipped with a Dexter Valve Reseating Outfit.

With Dexter equipment, your leaky valves can be reseated, in a few minutes, *right on the line*. One man can do the job, and your valves will be as tight as new.

Write us about your valve leaks. We'll give you complete information about the proper Dexter Reseating Machines and Cutters to take care of your valves — from now on.

8

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

YARWAY INVOLUTE SPRAY NOZZLES

Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from ¼ in. to 2½ in. Write for Catalog N-616.

YARNALL-WARING COMPANY
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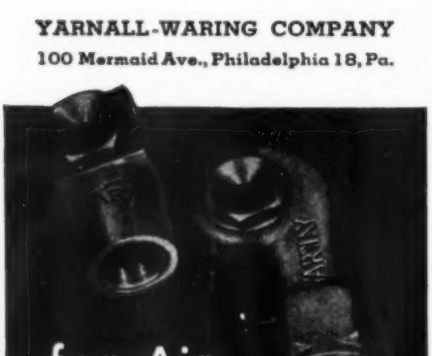


COE DRAINATOR

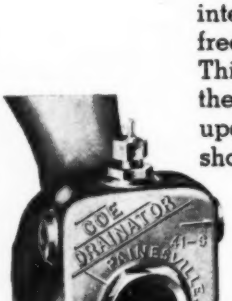
Has Everything COE Want you in a Steam Trap PLUS

THESE IMPORTANT ADVANTAGES

- **Continuous Operation**
- **Complete Absence of Moving Parts**
- **Visible Indication of Operation**

You want top efficiency in all steam conveying and using equipment through quick and complete removal of condensate, air and non-condensible gases.

You get it in this extremely simple steam trap...not intermittently...but for long periods with remarkable freedom from adjustments, maintenance and repairs. This because Drainator operates on an unvarying thermo-dynamic principle and is not dependent upon the moving parts that are responsible for the shortcomings common to conventional traps.



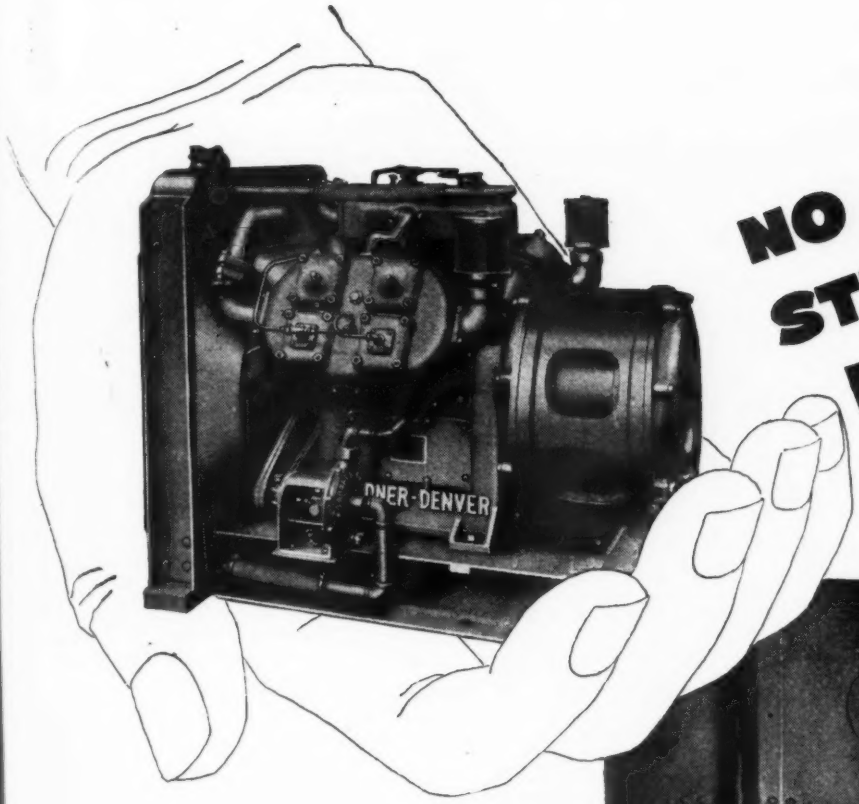
Model M-41-S DRAINATOR

Get typical Drainator performance in this smaller, lower priced unit, equipped with magnetic operation indicator and adapted for a majority of the loads usually put on ½" traps.

The COE MANUFACTURING Co.
PAINESVILLE, OHIO

DRAINATOR • THE ADVANCED STEAM TRAP

Write for a copy of Bulletin No. 903-A or ask us to send an engineer to discuss your condensate handling problems.



NO SPACE STRETCHER NEEDED!

You don't need a "space stretcher" when you install a Gardner-Denver "WB" Two-Stage Vertical Air Compressor in your plant.

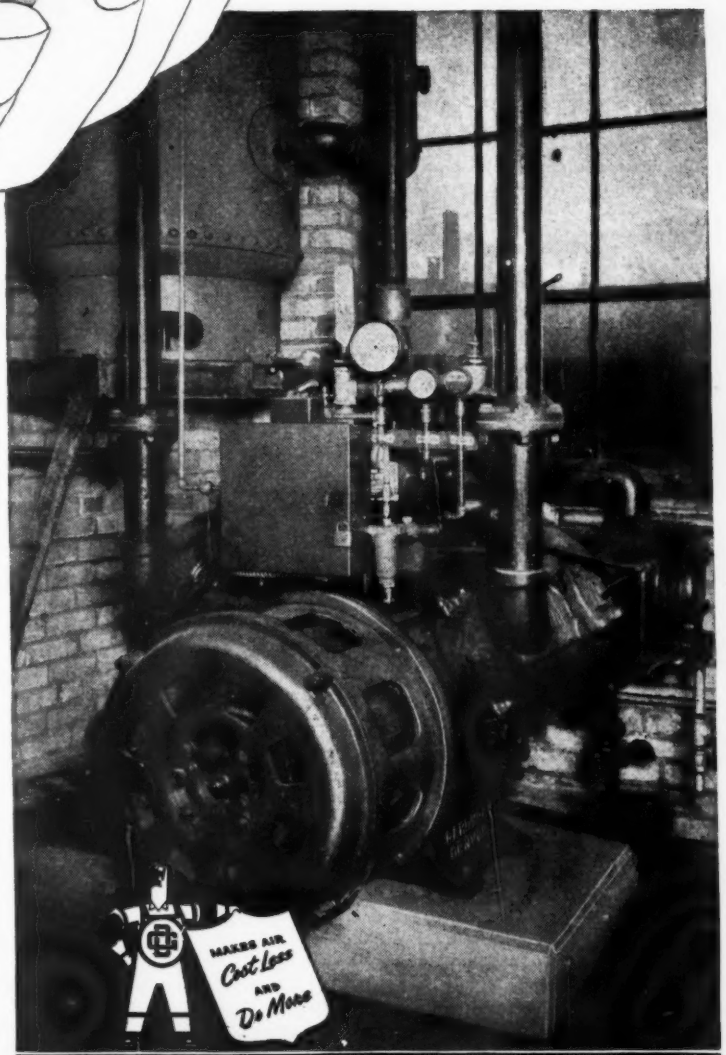
For these Gardner-Denver Compressors are designed to combine unusual compactness with air output comparable to that of large Two-Stage Horizontal Compressors.

A distinctive design feature is the use of two small-diameter, low-pressure cylinders in conjunction with each high-pressure cylinder . . . instead of a single large one . . . permitting the use of small, lightweight pistons in all cylinders.

Thus, the inertia load is reduced, making possible considerable reduction in compressor size.

Note These Design Advantages

1. Fully water-cooled cylinders for lubricating oil economy and lower discharge temperatures. A self-contained unit as far as cooling water is concerned . . . no outside water piping required.
2. Extra strength and hardness assured by GarDurloy—the special high-strength alloy iron.
3. Drop-forged crankshafts mounted on Timken roller main bearings.
4. Capacities ranging from 142 to 445 cubic feet displacement per minute.



Since 1859

GARDNER-DENVER

For complete information on Gardner-Denver "WB" Compressors, write for illustrated bulletins. Gardner-Denver Company, Quincy, Ill.

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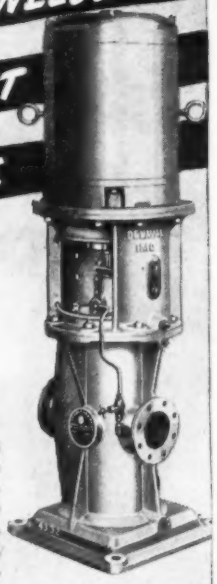
COMPACT
SIMPLE



IMO
I MOVE OIL

The **DE LAVAL ROTARY OIL PUMP** has only 3 moving parts, no gears, no valves and no separate bearings. It propels any grade of oil in any volume in a smooth, steady stream against any pressure, like a piston moving always in one direction. The IMO motor-driven pump here shown is one of five in lube oil service on each of the largest and fastest Great Lakes ore carriers.

Ask for Publication I-106

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton, New Jersey

PATCH FLOORS
. . . while Traffic Rolls

Roll a drum of INSTANT-USE over to the hole in the floor—remove the lid—shovel out enough to fill the hole—tamp smooth—and open the spot to regular traffic immediately, without waiting. You'll have a tough, solid, permanent patch that formerly took 24 hours to get. This rugged, new plastic bonds tight to old concrete, withstands extreme loads. Keep a drum on hand. Immediate shipment.

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THIS IS THE **4th** of a series explaining why G-T PACKINGS give better service.

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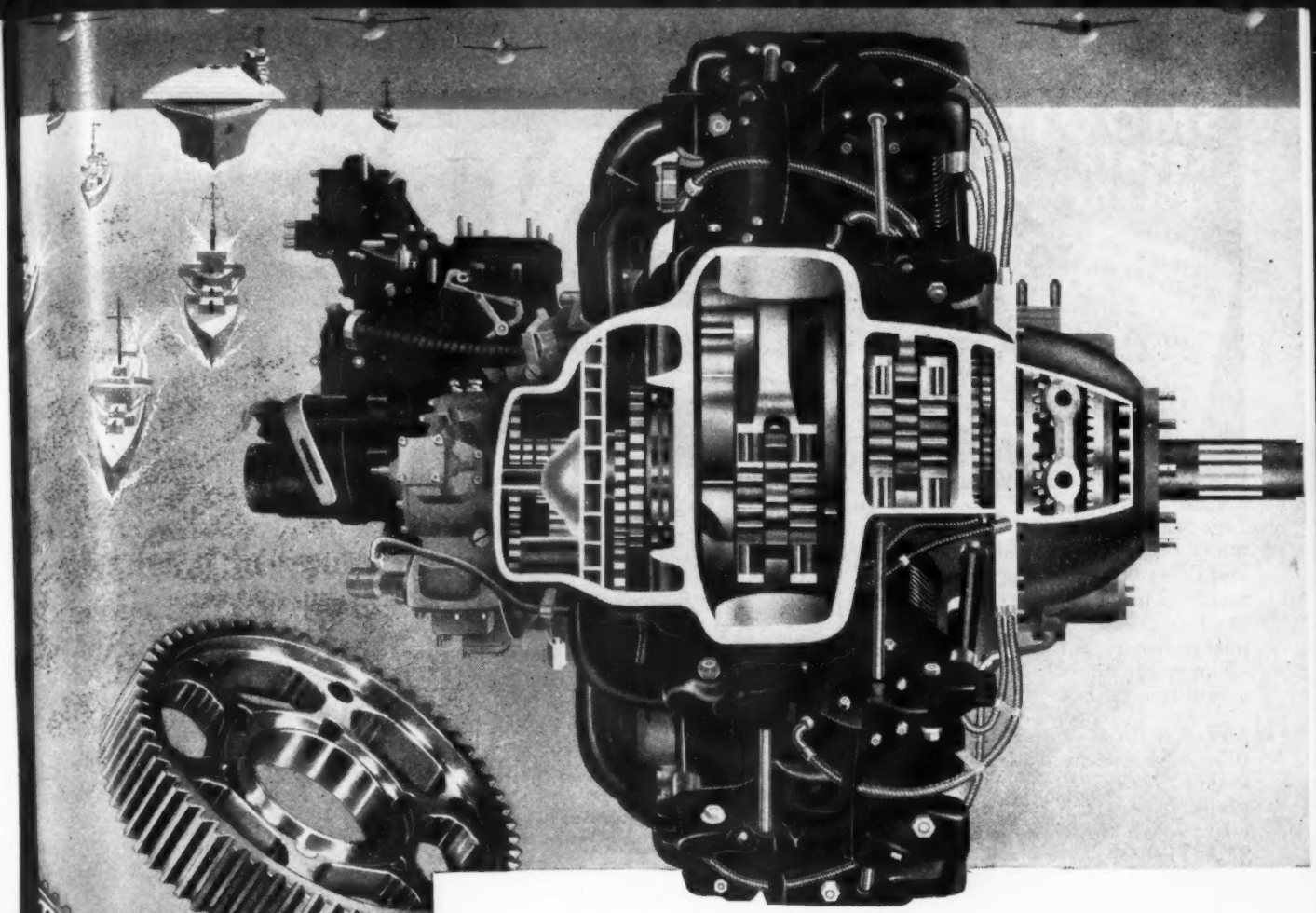
G-T *self-lubricating* PACKINGS



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EVER look inside a Twin Wasp engine? Here the power of 1200 horses is packed in a space no wider than your outstretched arms.

And notice the gears in this mighty engine—gears so compact and necessarily so light in weight that only extreme precision makes it possible for them to carry their tremendous load.

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ARMY E NAVY

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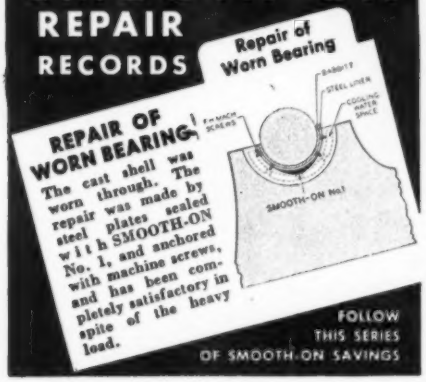
Better Power Transmission Through Better Gears

SMOOTH-ON REPAIR RECORDS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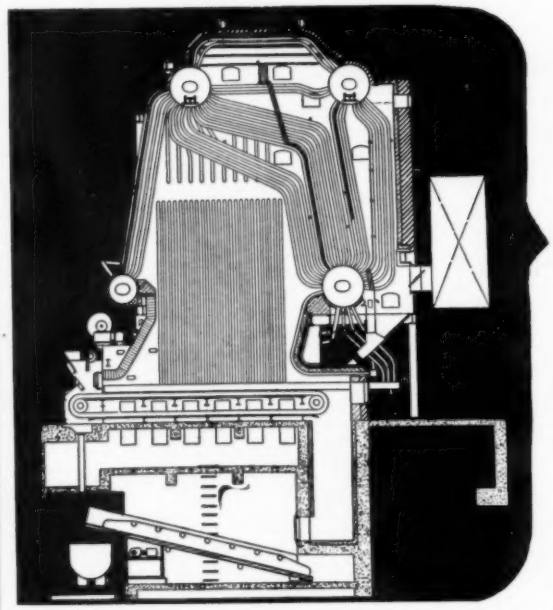

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THIS is a patented 4-drum boiler design that doubles the usual radiant exposure found in 4-drum boilers. This Union front wall radiant element, together with the main tube bank, form an "A" shaped roof over the fire. This added radiant exposure by absorbing fully ten times more B.T.U.'s per sq. ft. than the blind or convection heating surface, provides faster steaming, greater capacity, lower furnace temperatures and maintenance, and lower setting costs. These advantages and many others are completely described in Bulletin RB. Write for copy.

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- A-TYPE
- RADIANT TYPE
- L-TYPE
- 4-DRUM
- O-TYPE
- LONG DRUM
- CROSS-DRUM
- UNIVERSAL STEEL-CASED
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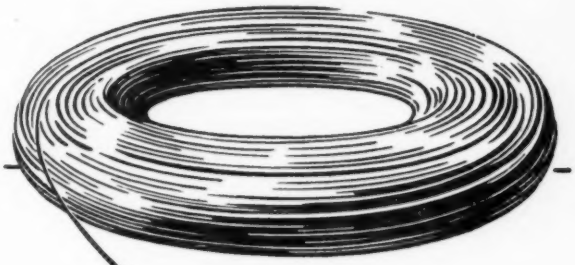
- HORIZONTAL RETURN TUBE
- LITTLE GIANT
- HEATING

UNION IRON WORKS * ERIE, PA*

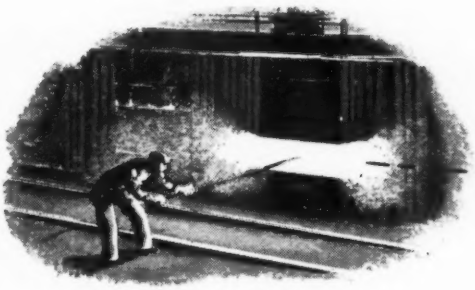
BOILERS

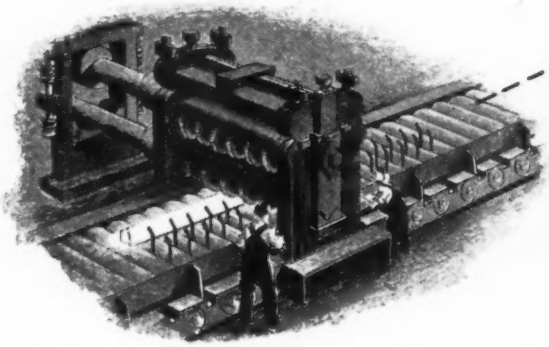
PRESSURE VESSELS • PLATE FABRICATION

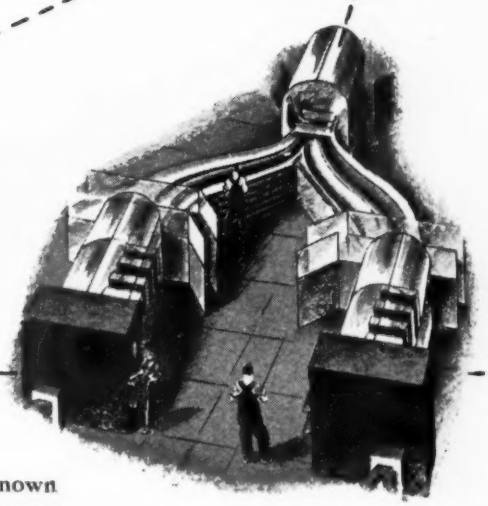
Open hearths, blooming mills, rod and wire mills, all aimed in one direction... the production of specialized wire ...the best we can make...



ROEBLING "Blue Center" STEEL WIRE ROPE







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TRENTON 2, NEW JERSEY • Branches and Warehouses in Principal Cities

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Wire Rope and Strand • Fittings • Cold Rolled Strip • Aircord, Swaged Terminals and Assemblies • Round and Shaped Wire Wire Cloth and Netting • High and Low Carbon Acid and Basic Open Hearth Steels Suspension Bridges and Cables • Electrical Wires and Cables • Aerial Wire Rope Systems

Cutout section shows locking ring in place.

Pat'd & Pat's Pend'g.

The SELF-LOCKING NUT

A built-in, self-energizing locking ring which operates on the brake band principle keeps the "Unshako" securely in place no matter how severe the vibration, yet it can be readily removed with a wrench and used over again many times. Write for full details.

OVER 40 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA., BOX 577

Your Up-to-date

HANDBOOK

of the Latest in Power-field Practice

USE EVERY ISSUE

***THERE* IS WHY IT IS GOOD BUSINESS TO SEE THAT YOU GET**

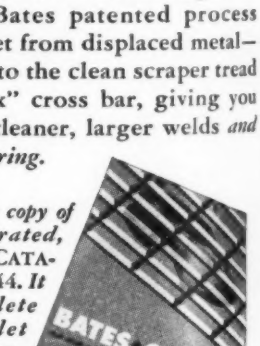
BATES-GRATES

FOR OPEN STEEL FLOORING

That scraper edge on the Bates open steel flooring cross bar is cleaner and safer. You grasp the idea from even a quick glance at the picture. Yet it doesn't cost you a cent more.

You get those extra advantages because the Bates patented process builds a fillet from displaced metal—in addition to the clean scraper tread of the "Hex" cross bar, giving you smoother, cleaner, larger welds *and stronger flooring.*

Write for copy of well-illustrated, 8½" x 11" CATALOG NO. 43-44. It gives complete data on fillet welded Open Steel Flooring and Stair Treads.



WALTER BATES COMPANY, INC.
JOLIET • ILLINOIS
OPEN STEEL FLOORING • STAIR TREADS

★ Star Performers ★

IN MANY OF AMERICA'S BIGGEST WAR PLANTS

NICHOLSON
PISTON-OPERATED STEAM TRAP

Skillfully designed to drain and discharge enormous quantities of water, dirt, boiler compound, scale and other foreign matter removed from steam by purifiers. Also recommended for separators, heaters, headers, long pipe lines and wherever an extra-large capacity trap is required. For pressures to 650 lbs. Non-collapsible chrome-nickel steel float. Vital working parts of stainless steel.

NICHOLSON
COMPRESSED AIR TRAP

NICHOLSON "Model JR" Compressed Air Traps are specially designed to provide long, trouble-free service in automatically draining air tanks, separators, receivers, after-coolers, etc. Water-sealed discharge valve, welded stainless steel float. Large capacity, pressures to 200 pounds. Intermittent discharge. Bulletin No. 341.

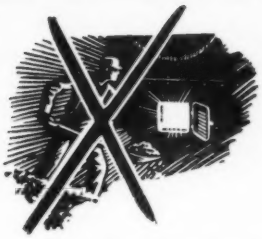
NICHOLSON
WEIGHT-OPERATED STEAM TRAP

Suitable for draining all types of equipment utilizing, storing or conditioning steam, air or gasoline, such as Separators, Line Purifiers, Water Heaters, Tanks, Gasoline Accumulators, Superheated Drains, Turbine Throttle Valve Drips, After Absorbers, etc. For pressures to 1500 lbs. at 1000 degree maximum temperature. All valves, seats and working parts are of stainless steel for long trouble-free operation.

Write for Trap Catalog No. 941 **W. H. NICHOLSON & CO.** ***125 Oregon St. Wilkes-Barre, Pa.***

IRON FIREMAN

SAVES 22½% COAL TONNAGE



View of stoker installation while construction was in progress at Egyptian Powder Co., Herrin, Ill.

Replaces Hand Firing at Egyptian Powder Company

AFTER years of hand-firing, the Egyptian Powder Co., Herrin, Ill., installed four Iron Fireman No. 5 CLC automatic coal stokers in 1941. According to Mr. R. C. Faris, Engineer for the company, the following results have been attained through the use of Iron Fireman:

1 **COAL SAVING:** 22½% reduction in coal tonnage.

2 **MANPOWER SAVING:** Expanded operations have required no additional manpower in the power plant.

3 **INCREASED EFFICIENCY:** Three boilers now carry the load comfortably, whereas four were required with hand-firing. Iron Fireman has provided a "spare" boiler.

4 **UNIFORM STEAM PRESSURE:** Uniform steam pressure is now readily maintained for engine operation.

In the interest of coal conservation, and your own plant efficiency—as well as labor savings and money savings—find out what Iron Fireman can do for you.

Iron Fireman Stokers are Available

Because their performance contributes so greatly to the nation's war economy, Iron Fireman commercial and industrial stokers are in full wartime production. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Manufacturing Company, 3511 West 106th Street, Cleveland 11, Ohio.

IRON FIREMAN AUTOMATIC COAL STOKERS

This is a bunker model; feeds from main bin direct to fire. Outstanding performance of Iron Fireman stokers is the result of the application of sound principles of combustion and engineering. Coal is fired under forced draft, with automatic regulation of air and coal to produce efficient combustion. Sizes now available for firing commercial and power boilers up to 1000 h.p. and larger. Pneumatic Spreader models burn low grade high ash and clinkering coals as readily as higher grade coals. Bunker-feed type eliminates coal handling.

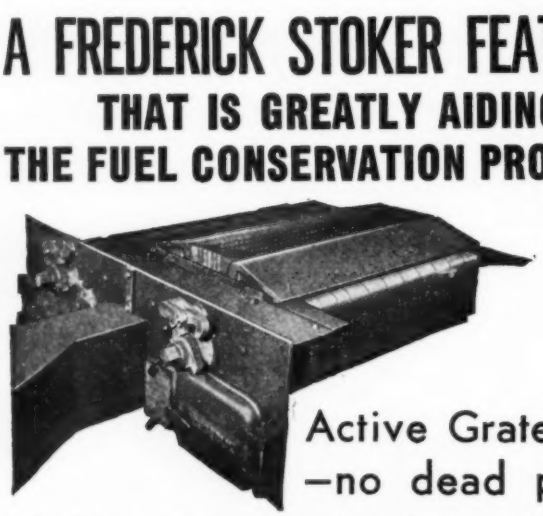
THE BIG JOB

Mercoid Pressure and Temperature Controls are now almost entirely confined to vital industrial requirements. They carry the highest war priority and find their way into war plants everywhere throughout the country, where they are doing their important part in the big job of essential production.

THE MERCOID CORPORATION • 4205 W. BELMONT AVE. • CHICAGO, ILL.

A FREDERICK STOKER FEATURE!

THAT IS GREATLY AIDING THE FUEL CONSERVATION PROGRAM



Active Grate Area —no dead plates!

Reduced tonnage is the rule in plants where Frederick Stokers are installed, and important savings in transportation and labor thereby assured.

The increased grate area of the FREDERICK BURNING END results in a low combustion rate per square foot, and underfeed firing thoroughly burns every bit of coal—fully utilizes the heat-giving gases.

Other Frederick features are fully described in our new Stoker Bulletin. Write for your copy—there's no obligation.

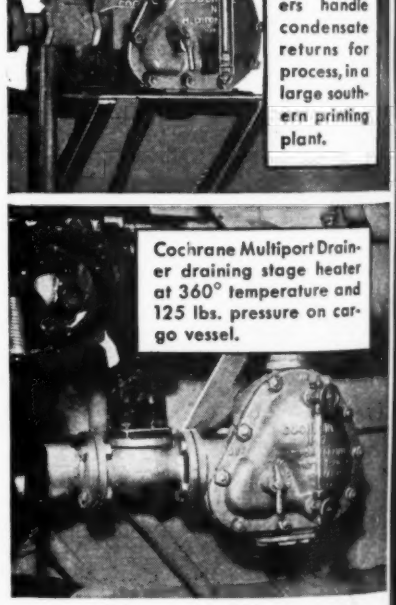
THE *Frederick* IRON & STEEL CO.
Frederick, Maryland

Tribute to a Great Drainer

"These traps" (Cochrane Multiport Drainers) "discharge continuously, the valve opening being determined by the height of water in the float chamber; the larger the volume of water, the larger the valve opening. The rotating movement of the sleeve valve serves to keep the valve free of sludge accumulation."

—Steam Engineer of large New England paper mill.

Two Cochrane Multiport Drainers handle condensate returns for process, in a large southern printing plant.



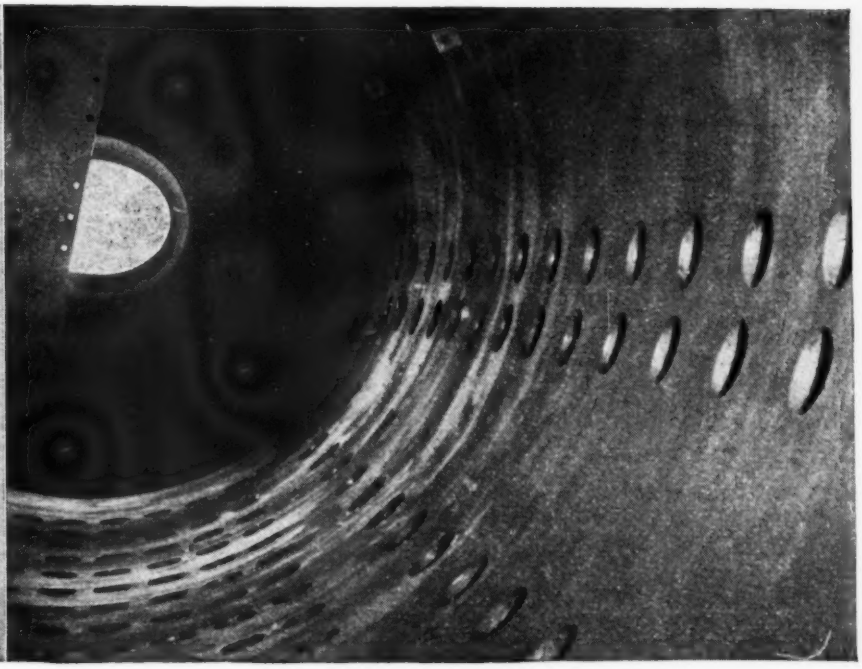
Cochrane Multiport Drainer draining stage heater at 360° temperature and 125 lbs. pressure on cargo vessel.

Write for a copy of Publication 2925.

COCHRANE CORPORATION
3106 N. 17th Street, Philadelphia 32, Pa.

COCHRANE DRAINERS

Scrap?... Reduce Pressure? ...No, APEXIORIZE!



APEXIOR GIVES BOILER METAL YEARS OF EXTRA SERVICE

Looks, fortunately, are often deceiving. Boilers that appear to be ready for the scrap pile or for operation at reduced pressure, have often been restored to good operating condition by APEXIOR. If they can pass inspection and a hydrostatic test, this long-lasting, corrosion-resistant, scale-resistant covering will "peg" that condition for more years of good performance.

APEXIOR seals up the pores and joints. It is applied with a hand brush or power coater after cleaning down to bare metal. One application lasts 2 to 3 years, and is easily renewed when worn too thin for protection. APEXIOR takes the wear . . . not the metal.

RECOMMENDED BY BOILER INSURANCE COMPANIES

Painting boiler metal is recommended by boiler insurance companies. Hundreds of industrial power plants, utilities, railroads and marine operators have been following their suggestions. And manufacturers of turbines coat shafts, rotor bodies and frequently interiors of casings with APEXIOR to lengthen the life of the metal and to facilitate its periodic cleaning.

So, before you start worrying about how to replace your aged equipment, have it tested . . . then APEXIORIZE if it passes the examination.

APEXIOR is a safe, sure answer to lack of new equipment . . . the solution to your problem of getting more out of your present equipment.

Save metal . . . extend time between boiler cleaning . . . make cleaning easier . . . APEXIORIZE.

Users like these have applied APEXIOR for years

It will help you get more service from irreplaceable equipment

The Solvay Process Co.
Ingersoll-Rand Co.
Puget Sound Power & Light Co.
Rockefeller Center, Inc.
Yale University
New York Central System
Chatham Manufacturing Co.
Pennsylvania Sugar Co.
Federal Shipbuilding & Dry Dock Company
Aluminum Co. of America
Allis-Chalmers Mfg. Co.

Ease of applying APEXIOR explained—Cleaning simplified. Write, today for Bulletin 1290 (Industrial) or 1305 (Marine) telling how to get peak production with peak protection.

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY of America**
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

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Company.....

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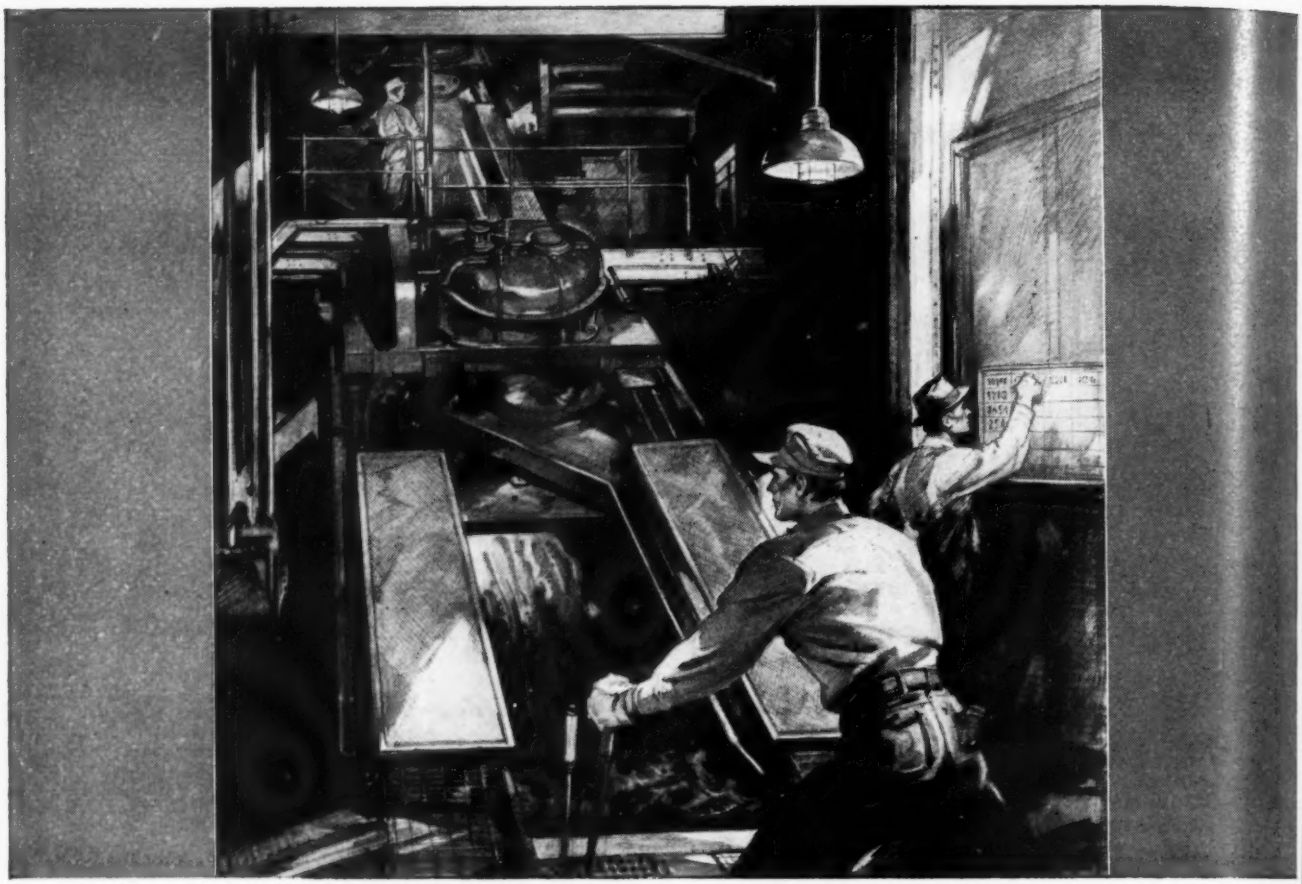


LAUNDERED COAL IMPROVES STEEL

At the steel plants, coal is laundered by washing and drying to rid it of impurities. This operation, as well as others born of coal research – the sampling, testing and blending of coal at the mines – contributes to production of stronger, cleaner-burning coke, the fuel for blast furnaces. With better coke, more and better iron is produced and the tonnage and quality of steel improved.

Research at the mines and limestone quarries and in the steel plants, improves and safeguards quality and advances production of new steels which are now helping to win the war. After the war is won, these new steels will continue to serve America by contributing to peace-time prosperity.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

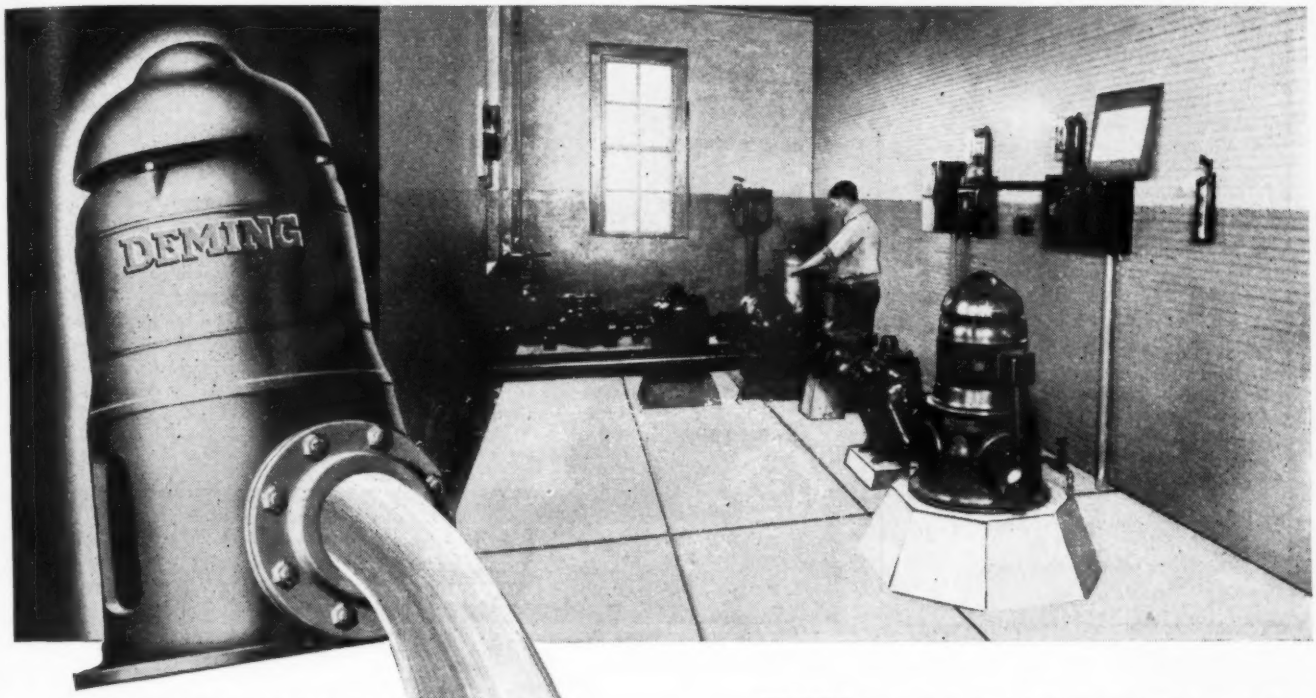
J&L STEEL

CONTROLLED QUALITY STEEL FOR WAR

J&L STEEL

2 Years 3 Months

CONTINUOUS OPERATION



NOTE THESE POINTS ABOUT DEMING TURBINE PUMPS

Water Lubricated. Cutless rubber bearings flood with water being pumped.

Sustained High Efficiency. Semi-open adjustable type impellers can be easily adjusted from ground level. Stuffing box located in discharge head.

Compact. Requires minimum floor space and allows pumping unit to be placed at any depth from surface.

Selectivity. Vertical hollow-shaft motors are standard construction but practically any type of head can be supplied where required.

WATER is not a "critical material" but lack of it, or excessive cost of it, can cause critical conditions.

To help you avoid those critical conditions is the job of Deming Deep Well Turbine Pumps. Their features of design, construction and operation are coordinated to produce pumping units of exceptional dependability and economy of water supply.

Wherever water of proper analysis, quantity and temperature is available, Deming Turbines make ideal pumping units within their range of capacities from 15 to 3000 g.p.m.

Send for 20-page, illustrated Bulletin 4700-8 and list of representative companies in YOUR type of business who own Deming Turbine Pumps.

THE DEMING COMPANY • SALEM, OHIO

DEMING

THE COMPLETE LINE

PUMPS AND WATER SYSTEMS

Make Your Overhead Valves SAFE And Easy to Reach---

With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.

This NON-CLOGGING PUMP
assures *UNINTERRUPTED* flow
...at Lower Maintenance Cost

Economy Vertical Non-Clogging Pump. Capacities 100 to 1500 G P M. Heads to 200 ft.

Helping Industry maintain continuous operations by preventing costly clogs *before they can occur*, is the special duty of Economy "Stand Up" Open Shaft Pumps. These units have generous sized clear waterways for handling unscreened sewage, miscellaneous pulps or trash without clogging. And, *uninterrupted* flow means greater gallonage per man-hour when man-power is limited. A few of the typical applications of these units are:

- Sewage Disposal
- Paper Pulps
- Underpass Drainage
- Sludge Removal
- Food Industries
- Reduction Plants

Motor is mounted in a yoke directly above the pump and *flexibly coupled* to the pump. The pump has its own heavy duty bearings and separate shaft. Perfect alignment is always assured. It will pay you to write for Economy's New Pump Data Book—free to Plant Executives and Engineers requesting their copy on company letterhead.

ECONOMY PUMPS, Inc.
HAMILTON, OHIO, U.S.A.

TRERICE
THERMOMETERS

No. A12402½ Industrial | No. M81110 Dial | No. M82115 Recording

TEMPERATURE CONTROLLERS

No. 90000 Self-Operating | No. V85002 Air-Operated Non-Indicating Type | No. M87000 Air-Operated Recording

PRESSURE GAUGES

No. 800 Steel Case | No. 600 Iron Case | No. 730 Hydraulic

Write for Catalog 101-G

H.O.TRERICE CO.
Manufacturers of Temperature Instruments
1420 W. LAFAYETTE BLVD.
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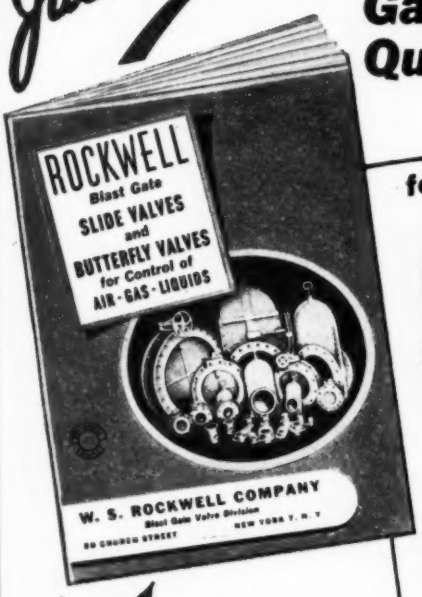
Just Out

Learn How To Get Easier Control of Air Gas • Steam • Liquids Quick-Tight Shut-Off



for Pressures to 25 p. s. i.

SLIDE VALVES
1" to 20" Sizes
Hand, Lever Wheel or Chain Control

BUTTERFLY VALVES

1" to 48" Sizes
Manual Lever, Wheel or Chain Control or Any Automatic Control

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W. S. ROCKWELL COMPANY
48 CHURCH ST. NEW YORK 7, N. Y.

NIGHT OR DAY

the Dearborn Engineer is at your service

● Dearborn Engineer lives with a hat on! He is accustomed to calls for help at all hours. Night or day, he is as near as your telephone to help you when you have trouble due to bad or improperly treated water.

Dearborn Engineer Knows Your Local Water Characteristics

● He lives and works where your plant is located. That's an advantage because he gets started quickly.

He is equally quick to detect trouble caused by improper treatment dosage or adjustment. In fact, he's an expert in preventive treatment to avoid trouble. In these days of round-the-clock boiler operation it's helpful to have this service at hand and available quickly.

Night or Day, Call Dearborn

● Dearborn treatment provides full protection to eliminate scale, stop corrosion, and reduce the possibility of steam contamination. Call our nearest branch office or write . . . Dearborn Chemical Company, Dept. D, 310 S. Michigan Ave., Chicago 4, Illinois.

Dearborn

TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE

{For Victory, Buy United States War Bonds and Stamps}

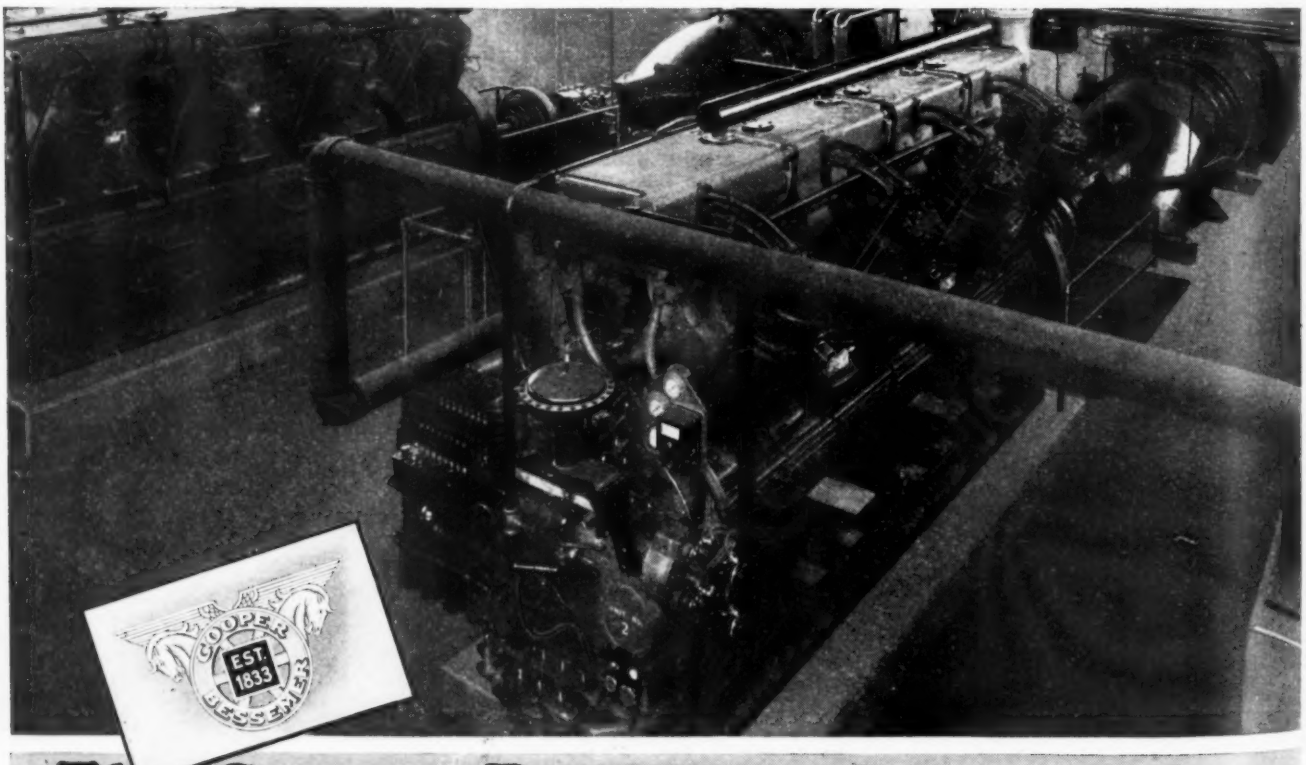
These TYPE G-MV ANGLE Engines Must Not Fail

Entire water supply of giant Port Neches synthetic rubber project is pumped by two continuous-running Cooper-Bessemers

Pumping 250,000 gallons of water a minute . . . 360,000,000 gallons a day . . . these two 800 hp Type G-MV gas engines supply all the water used in the vast $45,000,000 rubber project at Port Neches.

Engine speed and pumping performance are accurately regulated by special Cooper-Bessemer automatic controls, so that exactly the desired water volume and pressure are maintained constantly. It is significant of the confidence placed in Cooper-Bessemer G-MV's that they must run continuously, day and night, without standby equipment.

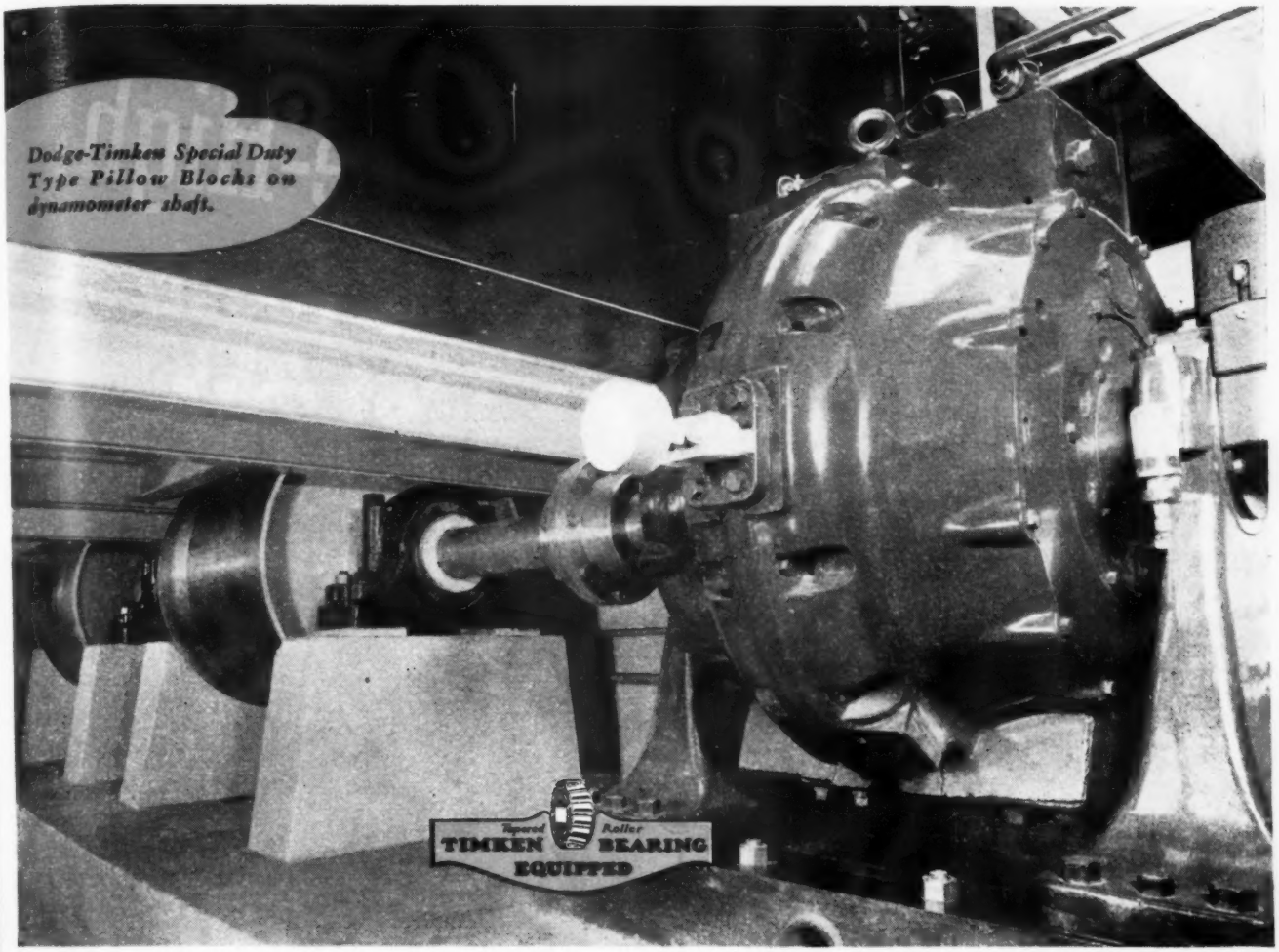
Dependability and freedom from operating troubles are well-known Cooper-Bessemer qualities—proved by millions of horsepower working steadily for years in the oil fields, in refineries, natural gasoline plants, gas transmission stations and processing plants. No wonder men turn to Cooper-Bessemer whenever they need utmost reliability in an engine or compressor.



The Cooper-Bessemer Corporation

Mount Vernon, Ohio — Grove City, Penna.

New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash.
Houston, Dallas, Greggton, Pampa and Odessa, Texas Tulsa Shreveport St. Louis Los Angeles

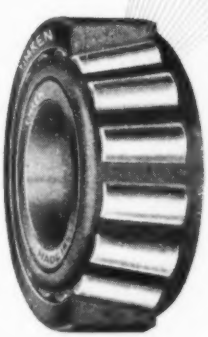


MAKING POWER PAY ITS WAY

POWER pays a full return in work done when shafts turn in Timken Bearing Equipped Pillow Blocks and Line Shaft Hangers for then there is no waste through friction; you don't pay for power that is not used.

Furthermore, you get the benefit of several other important economies, including fewer power interruptions; reduced lubricating cost; elimination of product damage through lubricant leakage; and lower maintenance expense.

For Timken Tapered Roller Bearings not only prevent friction; they provide protection against radial, thrust and combined loads and hold moving parts in correct and constant alignment.



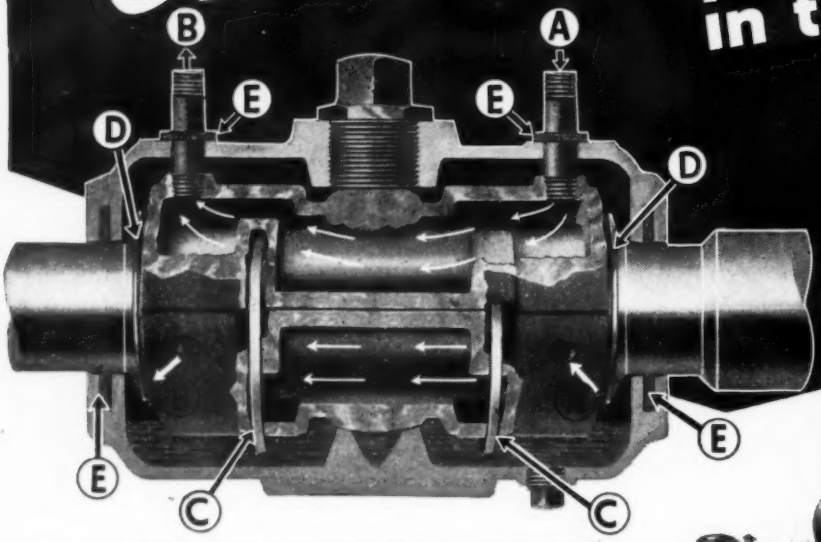
Check up on your power transmission equipment now and replace obsolete, wasteful line shaft hangers and pillow blocks with modern units containing Timken Bearings. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

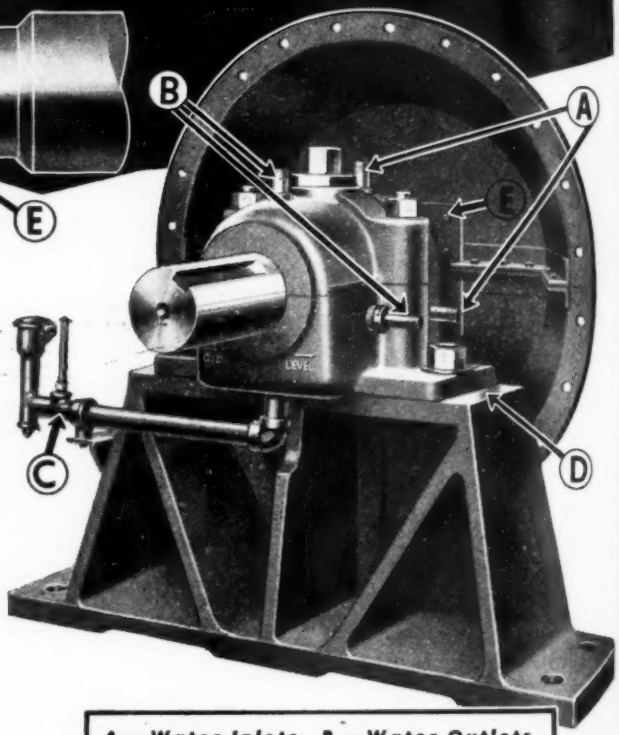
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Another Reason Why CLARAGE is Ace-High in this Toughest of ALL Fan Services



A—Water Inlets. B—Water Outlets. C—Oil Rings. D—Thrust Collars (forged, turned and ground); integral part of shaft. E—Seals prevent dust leakage into bearing.



A—Water Inlets. B—Water Outlets. C—Oil Filler Cup and Pipe. D—Bottom of Bearing and top of Support machined for accurate alignment. E—Shaft Seal prevents escape of gases from fan.

BETTER BEARINGS GUARD Against Operating Failures on Vital War-Time Jobs!

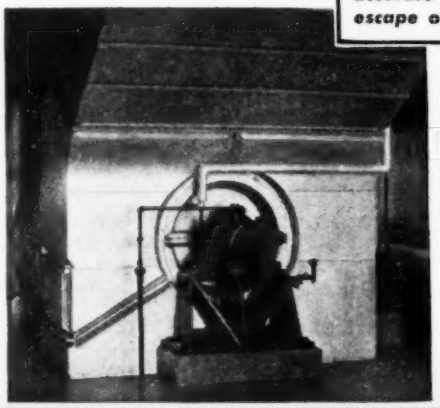
Wheel tip speeds may run as high as 4 miles per minute—temperatures may exceed 700° F.—that's modern induced draft—*toughest of all fan services!*

To meet such requirements successfully, Clarage Type RT Fans have water-cooled bearings of liberal size, as shown above. Note high grade construction and precision features.

Note, too, that cooling water is circulated through each half of the bearing sleeve independently of the other—no joints or gaskets—no possibility of water leaking into bearing lubrication.

These BETTER bearings are an important factor in assuring each Clarage RT Induced Draft Fan a trouble-free service life far longer than normal expectancy.

And this ability to out-perform and out-last is equally characteristic of other Clarage Fans and Blowers. If you have ANY war-time air-handling problem, it will pay you to get in touch with us.

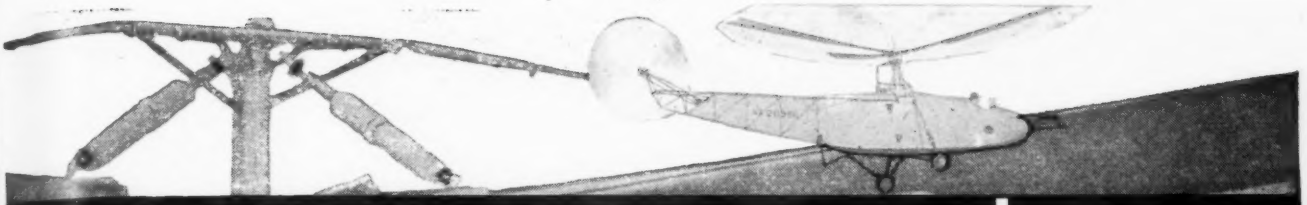


RT Induced Draft Fan servicing public utility—one of over 2,000 Clarage power plant installations. Water-cooled bearings in foreground — big husky ones OK for any operating condition.

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

Clarage Fan Company Kalamazoo, Mich.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES



SAFEGUARDING THE HELICOPTER'S HEART

One feature that has played an important part in the success of the Sikorsky helicopter is the development of "cyclic pitch control."

The mechanism that operates this control passes through the main rotor hub.

It is the heart of the helicopter.

And you will find this heart fastened safely and securely with Elastic Stop Nuts.

These are the nuts with the red elastic collar—the nuts which have revolutionized aircraft construction.

That red collar hugs the bolt and grips tight. It does not loosen under vibration or shock. It locks fast—anywhere on the bolt.

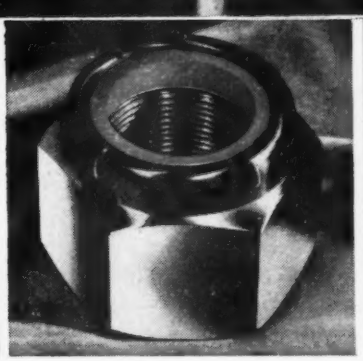
Nevertheless, you can take Elastic Stop Nuts off, and put them back on, time and time again, and they still retain their locking effectiveness.

Elastic Stop Nuts are going to prove godsends in countless postwar fastening problems. They will make products safer, better and longer lasting.

Any time you wish, our engineers will be glad to help with whatever fastening job you might have. They will recommend the correct Elastic Stop Nut to meet the situation.

Elastic Stop Nuts are an old story on Sikorsky aircraft. They have been used on the Sikorsky clipper ships for years. They are found throughout the helicopter holding important structural fastenings.

LOCKED ON THE BOLT BY THE ACTION OF THE GRIPPING RED COLLAR.
THE COLLAR IS ELASTIC, THE NUT CAN BE USED TIME AND TIME AGAIN.
MADE IN ALL SIZES AND TYPES—WITH THREADS TO FIT ANY STANDARD TYPES OF BOLTS.



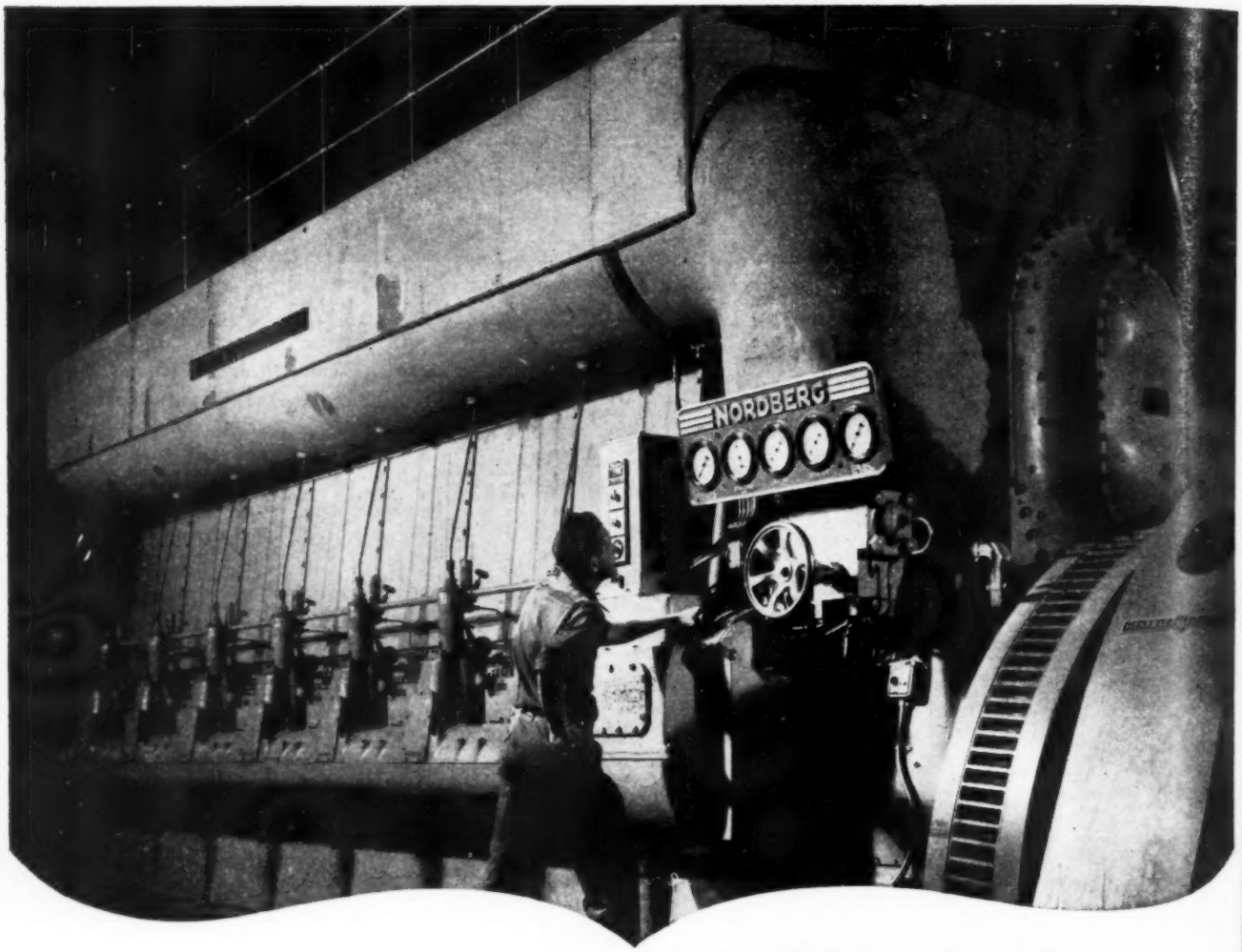
ESNA

TRADE MARK OF

ELASTIC STOP NUT CORPORATION OF AMERICA
UNION, NEW JERSEY AND LINCOLN, NEBRASKA

ELASTIC STOP NUTS

Lock fast to make things last



Better Lubrication with Gulf Parvis Oil *means Lower Maintenance Costs!*

Gulf Parvis Oil provides the kind of protection your Diesels need now

Maintenance costs usually tell the story of lubrication efficiency—and Diesel maintenance costs are *low* with Gulf Parvis Oil in service.

This superior Diesel lubricant has been perfected during the last fifteen years through research effort and far-flung field service in most types of Diesels and under a wide variety of operating conditions. It has many outstanding performance records.

If you are not one of the hundreds of enthusiastic users of Gulf Parvis Oils, it will pay you to investigate—call in a Gulf Lubrication Service Engineer and ask him to recommend the proper type and grade to fit your particular requirements.

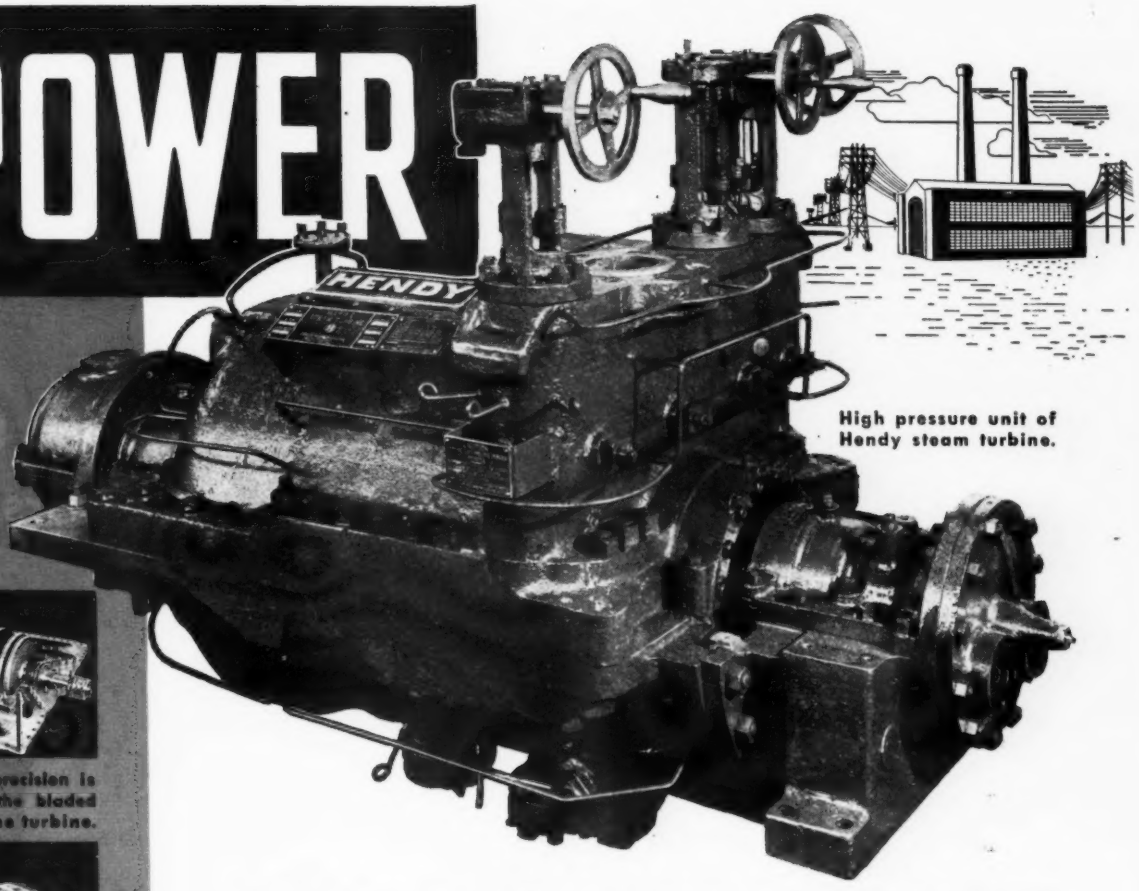
Gulf Parvis Oil—and the more than 400 other quality oils and greases in the Gulf line—are available to you through 1,200 warehouses in 30 states from Maine to New Mexico. Write, wire, or phone your nearest Gulf office today.

Gulf Oil Corporation · Gulf Refining Company · Gulf Building, Pittsburgh, Pa.

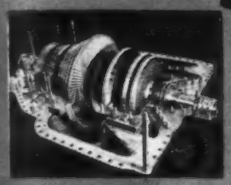
GULF INDUSTRIAL LUBRICATION

Back the attack . . buy more War Bonds

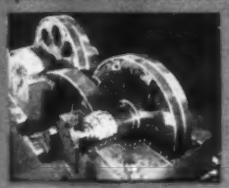
POWER



High pressure unit of Hendy steam turbine.



The utmost precision is essential in the bladed spindle of the turbine.



Hendy marine reduction gear unit for the 4,000 hp C-1 power plants.

THE BALANCE OF POWER

The assurance of long life and low maintenance for a turbine depends on how well such a power unit is balanced. One way is to build them—and then compensate for weight differences. But the correct way is to build each of the 4,000 parts so meticulously to precision dimensions in the first place that the unit doesn't have to be balanced by supplementary means. Then it will always remain in balance for there's nothing artificial about it!

For a smooth-running vibrationless unit—you can rely on the "balance of power" in a HENDY built turbine.

FOR THE SEA TODAY ...for INDUSTRY tomorrow

Challenged to put steam turbines on a mass production basis, Hendy telescoped into twenty months a decade of turbine manufacturing progress. In doing so a new chapter has been written in the history of turbine production, and as well new standards of quiet, smooth turbine performance have been created by the Hendy product.

Now entirely for marine service, the output from Hendy includes turbines for 300 kw generator sets, 4,000 hp, 6,000 hp and 8,500 hp turbines for propulsion of cargo ships—in addition to complete reduction gear units for them.

Post-war industry will find performance in Hendy turbines—will find them prime movers whose dependability has been thoroughly established in war service.

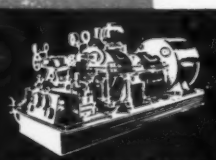
JOSHUA HENDY Division

JOSHUA HENDY IRON WORKS

ESTABLISHED 1856

SUNNYVALE, CALIFORNIA

BRANCH OFFICES: Boston · Buffalo · Chicago · Cincinnati · Cleveland · Detroit · New York · Philadelphia · Pittsburgh · San Francisco · St. Louis · Washington · Los Angeles



TURBO-GENERATORS

REDUCTION GEARS

STEAM TURBINES

DIESEL ENGINES

All these FIRE-CLAY Tubes Have Been Used In Thermix Ceramic Dust Collectors

INDIVIDUAL PRECIPITATING TUBE ASSEMBLY

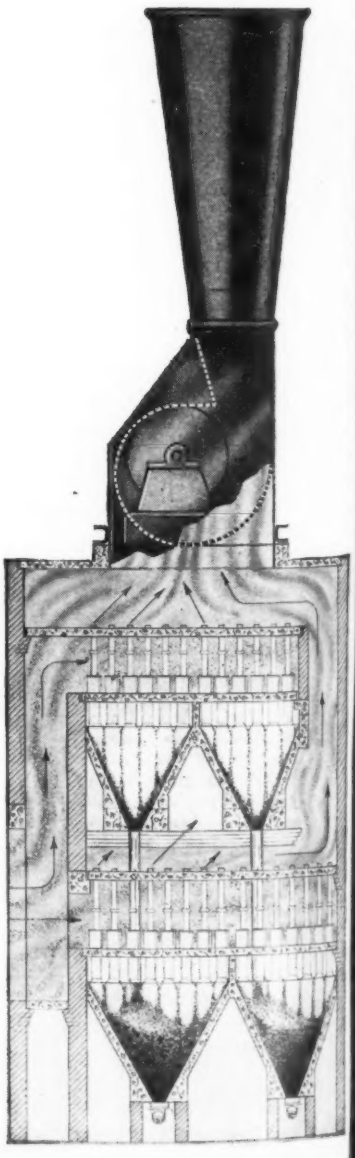
Industry has been quick to recognize the advantage of Thermix Dust Collectors with *ceramic*, instead of *steel*, tubes —not only because of the critical materials these ceramic tubes save but also because delivery can be made quickly and without a priority.

These practically indestructible ceramic tubes are harder than steel and they weigh no more per tube. Neither high temperature gases, nor corrosive low temperature gases containing sulphur, affect these fire-clay tubes.

Another thing . . . Thermix Ceramic Dust Collectors can be installed outside of the plant, if desired, without a protecting structure.

The design of the tubular dust collector constructed of non-priority material is basically identical with the Thermix Steel Dust Collectors now collecting fine dusts, powders and fly-ash in connection with 40,000,000 lbs. of steam capacity per hour.

DOUBLE-DECK ARRANGEMENT



Write for bulletin and full particulars.

Prat-Daniel Corporation, Port Chester, N. Y.

General Sales Agents

Thermix Engineering Co., Greenwich, Conn.

Representatives in Principal Cities

Thermix Ceramic DUST COLLECTOR

Have You a Traffic Jam

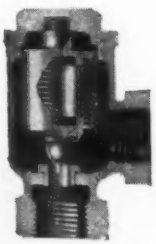
IN YOUR STEAM LINES?

Now, when the call is for more and more production, faster and faster, you cannot afford to have steam heated process equipment slowed up by sluggish steam coils or water-logged supply lines.

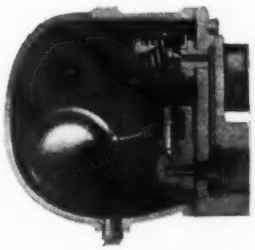
In other words, good steam traps now are more important than ever. Sarco makes four distinct types and can select the type to give you quickest air venting and maximum heating efficiency without lag or waste.

We can also suggest simple temperature controls which will prevent spoilage and stop wasteful overheating.

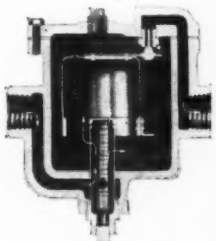
The Sarco Hook-Up Book contains helpful suggestions on proper selection of steam saving equipment and many tested hook-ups not published elsewhere. A copy is yours for the asking.



Sarco No. 9 thermostatic steam trap for individual trapping of steam coils.



Sarco float-thermostatic steam trap for tanks, lines, and temperature controlled hook-ups.



Sarco bucket trap for heavy duty and intermittent service.

Sarco No. 87 steam trap-control

Sarco temperature controls hold tank and process temperatures within a few degrees.

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

SARCO Saves Steam

Represented in Principal Cities

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

PEDRICK PRECISION *keeps them going!*

WHEN INVASION BARGES HEAD FOR SHORE—

● The powerful Diesel engines which drive these modern assault craft must not falter. And they don't! For American ingenuity has produced a power-plant of amazing dependability and ruggedness. So good, in fact, that the U. S. Navy testified that "the largest invasion operation in history was executed with maximum precision and minimum casualties, due in no small measure to the reliable power plants."

In the majority of these Diesel engines are Pedrick *precisioneered* piston rings, proving again by their performance that Pedrick's own Heat-Shaping process is unexcelled in producing accuracy of shape and tension, long life, and utmost dependability, no matter how tough the service.

This is the kind of performance every engineer, every superintendent of maintenance, every engine and vehicle owner wants in piston rings. They get it when they specify PEDRICK piston rings! WILKENING MANUFACTURING CO., Philadelphia and Scranton, Pa. *In Canada:* Wilkening Manufacturing Co. (Canada), Ltd., Toronto.

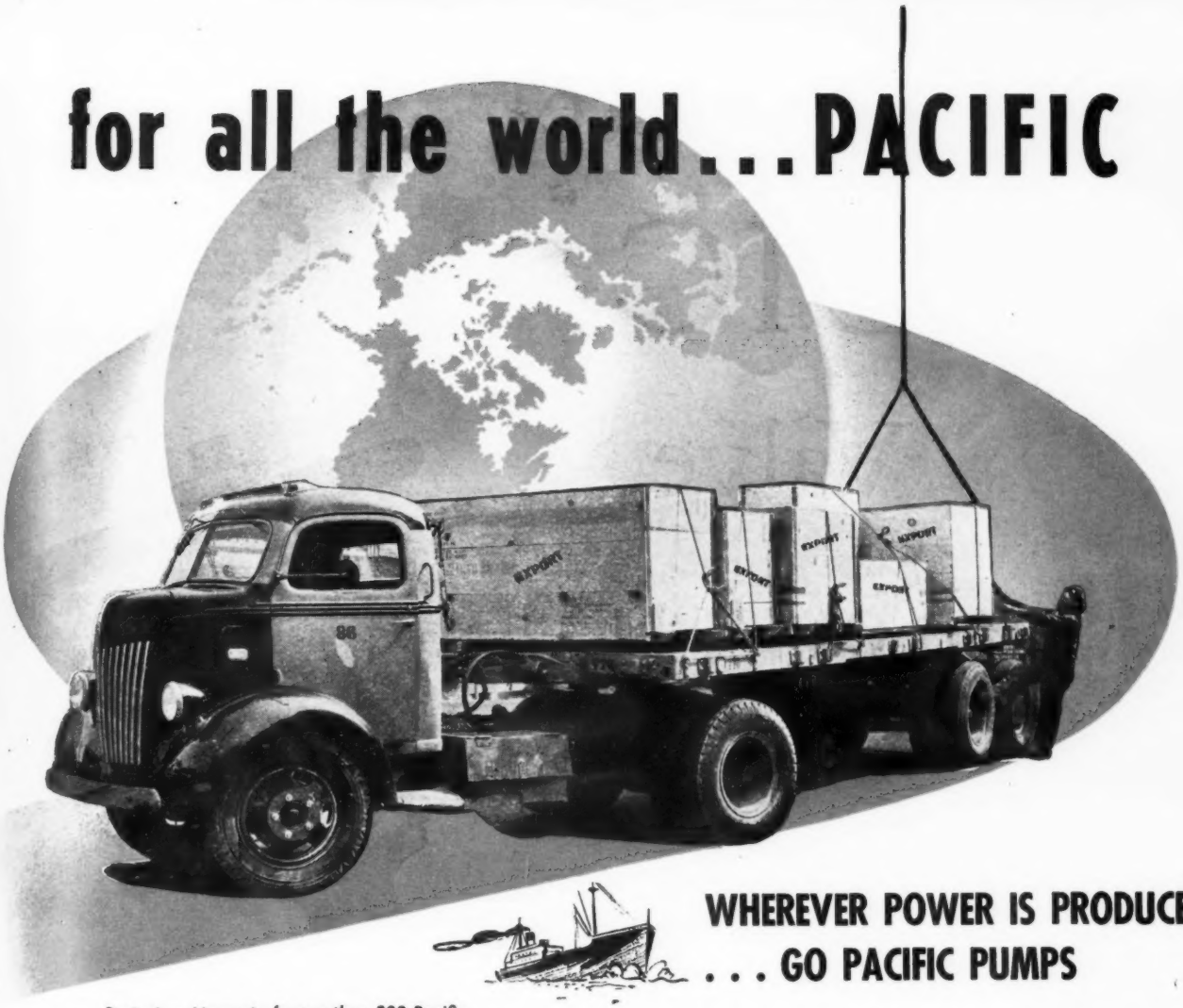
A WORD TO DESIGN AND MAINTENANCE ENGINEERS

A new 12-page booklet by Pedrick may suggest ways in which you can greatly improve the design or operation of the engines for which you are responsible . . . either those now in production or use, or those you plan for post-war. Write for Form 360 to find out how Pedrick combines materials, processes, designs, and experience to deliver *precisioneered* piston rings of unusual excellence.

Pedrick *precisioneered* **PISTON RINGS**

BUY WAR BONDS AND MORE BONDS

for all the world...PACIFIC



WHEREVER POWER IS PRODUCED . . . GO PACIFIC PUMPS

Part of a shipment of more than 300 Pacific Pumps leaving for overseas duty; destination, a military secret.

For a score of years, Pacific precision pumps have spoken a universal language in terms of "Uninterrupted, highly efficient pumping performance with long years of economical service."

On duty everywhere, in the power and utility field, on pipelines, in bulk plants—wherever liquids, hot or cold, are centrifugally pumped—where conditions are toughest and pumps take a beating—there you'll find Pacifics, giving more than was bargained for and at lower maintenance costs.

And now in wartime, when flow must be speedier and more constant, to assure a victorious peace, Pacific engineered design and construction are doubly recognized and demanded.

That's why Pacific is devoted 100% to war production. That's why shipment after shipment of Pacific pumps are moving in ever increasing numbers, to plants around the globe.

If you can buy Pacific pumps today or are planning future requirements, remember "Pacific has the ability and backing to carry through."

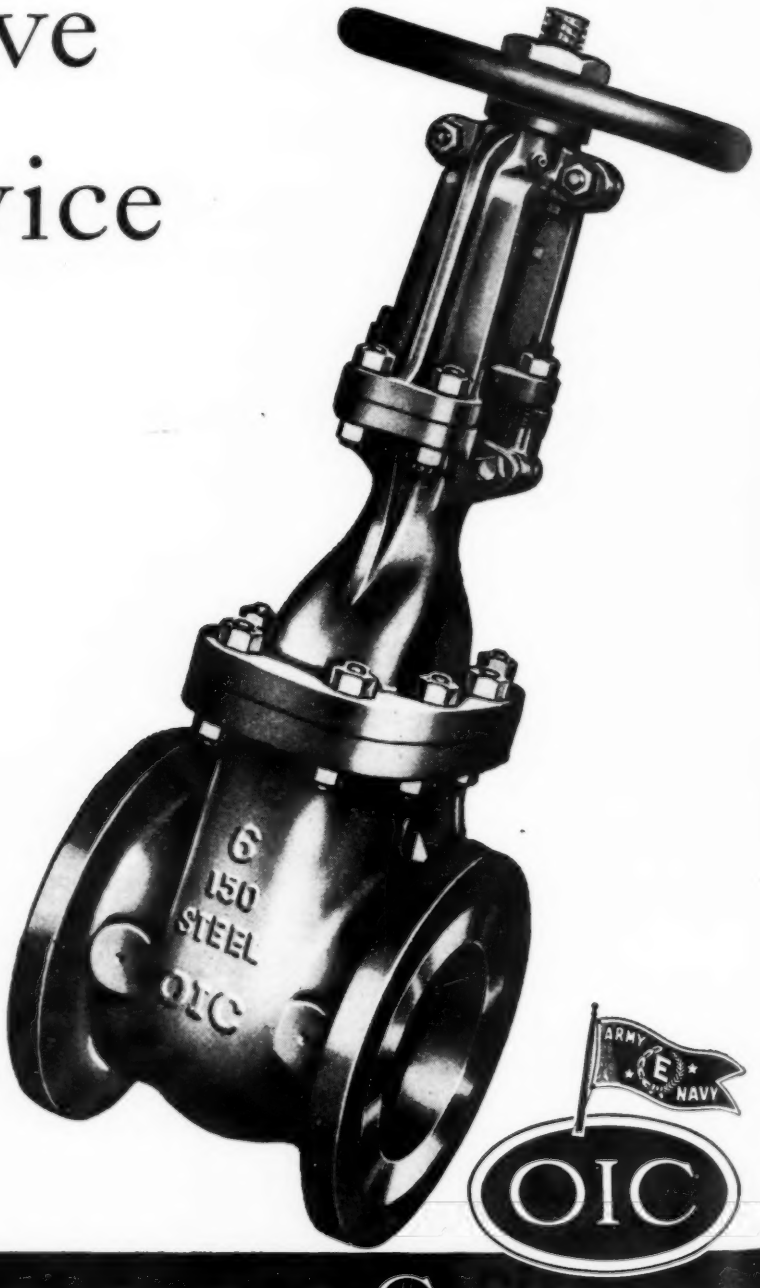
In Pacific's complete line of centrifugal pumps, there is a type and size to meet every variation in pumping conditions. Also pumps for water wells, deep oil wells, refineries, processing and synthetic rubber plants.

PACIFIC PUMP WORKS

Executive Offices and Plant: Huntington Park, California • *Export Office:* 30 Rockefeller Plaza, New York • *Sales and Service:* Offices in principal cities in the United States • *Affiliated Companies:* Dresser Manufacturing Co., Bradford, Pa.; Clark Bros. Co., Inc., Olean, N. Y.; The Bryant Heater Co., Cleveland, O.; Van der Horst Corp. of America, Cleveland, O., Olean, N. Y.; Bovaird & Seyfang Mfg. Co., Bradford, Pa.; Dresser Manufacturing Co., Ltd., Toronto, Ont., Canada.

PACIFIC *Engineered* PUMPS

Complete OIC Valve Service



OIC complete Steel, Iron and Bronze Valve service is as near to you as your nearest OIC Distributor. It's a service supported by sixty years of experience and Valve specialization.

There is an OIC ***Distributor Near You. Call him or write to us for complete information on*** OIC ***Steel Valves.***

ARMY E NAVY

OIC

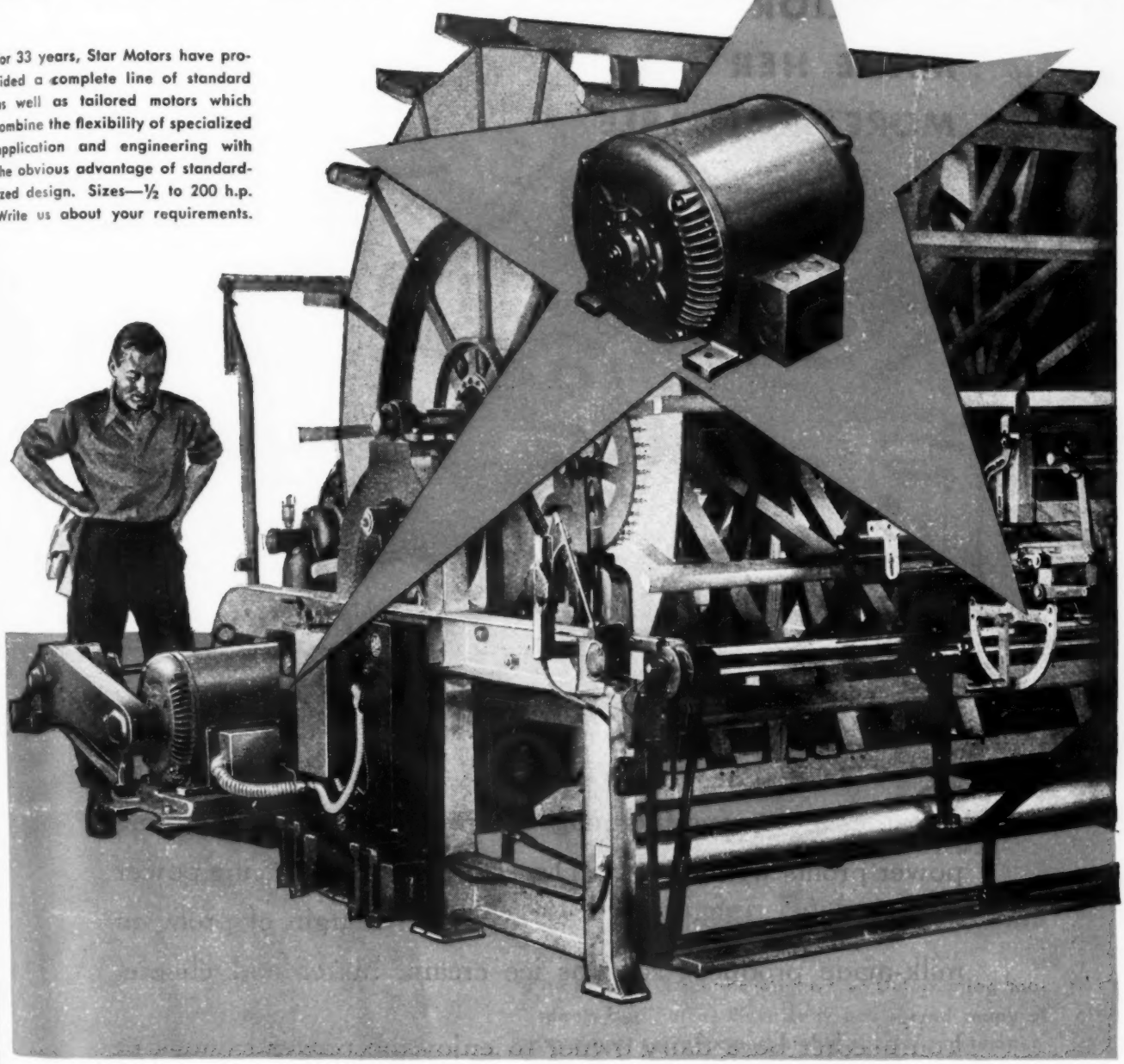
THE OHIO INJECTOR COMPANY

WADSWORTH, OHIO

Quality Leaders in Valve Manufacture Since 1883

IN THE TIGHT SPOTS IT'S A STAR

For 33 years, Star Motors have provided a complete line of standard as well as tailored motors which combine the flexibility of specialized application and engineering with the obvious advantage of standardized design. Sizes—½ to 200 h.p. Write us about your requirements.



Frequently Star is asked to fit *mechanical* "tight spots" with its unique welded construction that eliminates special patterns and castings. And just as often to fit engineering "tight spots." Sipp-Eastwood warping machines, for example, warp 500 yards of rayon, acetate or nylon a minute. To meet these high speeds, Star engineering provides motors that develop intermediate speeds in addition to the four fundamental speeds. Abnormally high torque is also provided at low speed. And all without special or costly construction. STAR ELECTRIC MOTOR CO., Bloomfield, N. J.

ARMY E NAVY

POWER PACKAGED AS YOU NEED IT

STAR MOTORS

SUPERIOR DIESEL MADE HER MILK MORE PROFITABLE

Dairies are among the many business organizations earning power profits with Superior Diesel engines. By reducing power expense, it is possible to realize a greater margin of profit on milk-made products, such as ice cream, butter and cheese.

You needn't be a dairy owner to enjoy the power savings of a Superior Diesel; the economy of this great engine is basic, and applies to all industries, institutions and municipalities.

Superior **DIESELS**

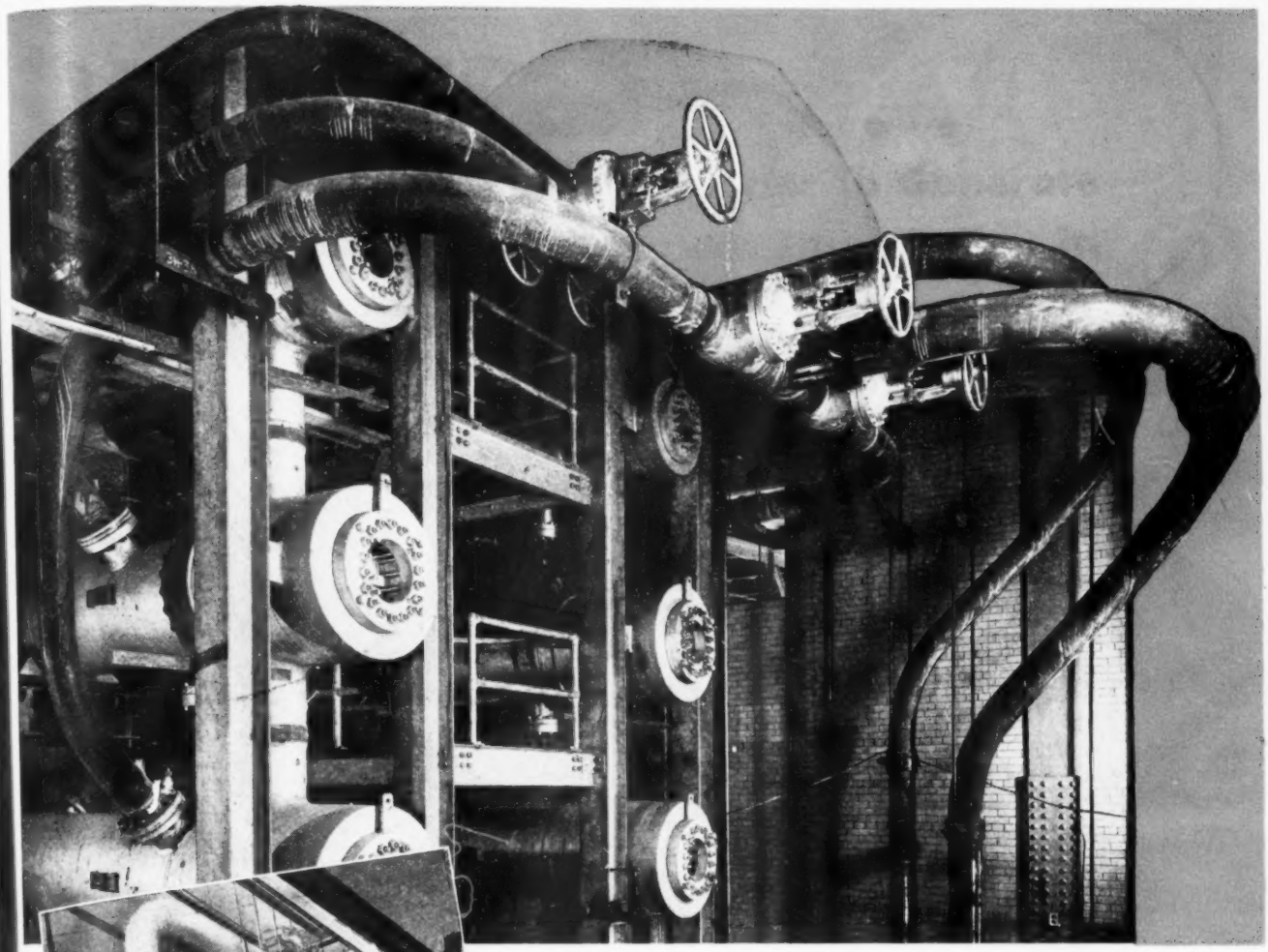
STATIONARY . . . 31 to 1160 H. P.
MARINE . . . . . 28 to 1160 H. P.
GENERATOR SETS . 12½ to 770 kw.

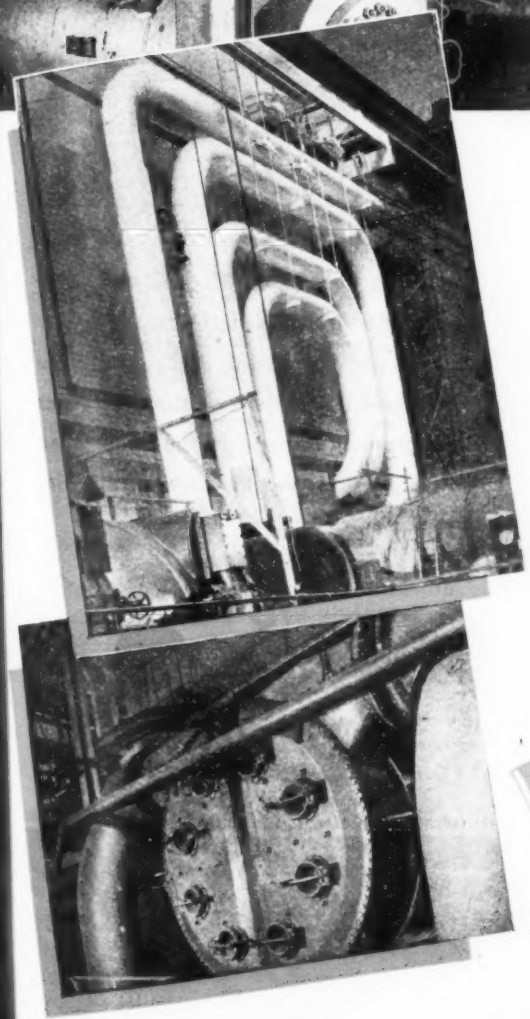
SUPERIOR ENGINES

Division of The National Supply Co.

Executive Offices: Pittsburgh, Pa.

Sales Offices: Springfield, Ohio; Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Washington, D. C.; Jacksonville, Fla.; Houston, Texas; Fort Worth, Texas; Tulsa, Oklahoma; Los Angeles, Calif.; Chicago, Ill. Factory: Springfield, Ohio.





KELLOGG Solves The Most Complex Piping Design Problems

The Kellogg Scientific Method of Determining Moments and Forces Electrically has solved many of todays most complex and highly specialized temperature and pressure problems. Prefabricated assemblies designed by this scientific method are installed in public utility, process and marine power plants.

When intricate piping problems arise consult Kellogg regarding this scientific method.

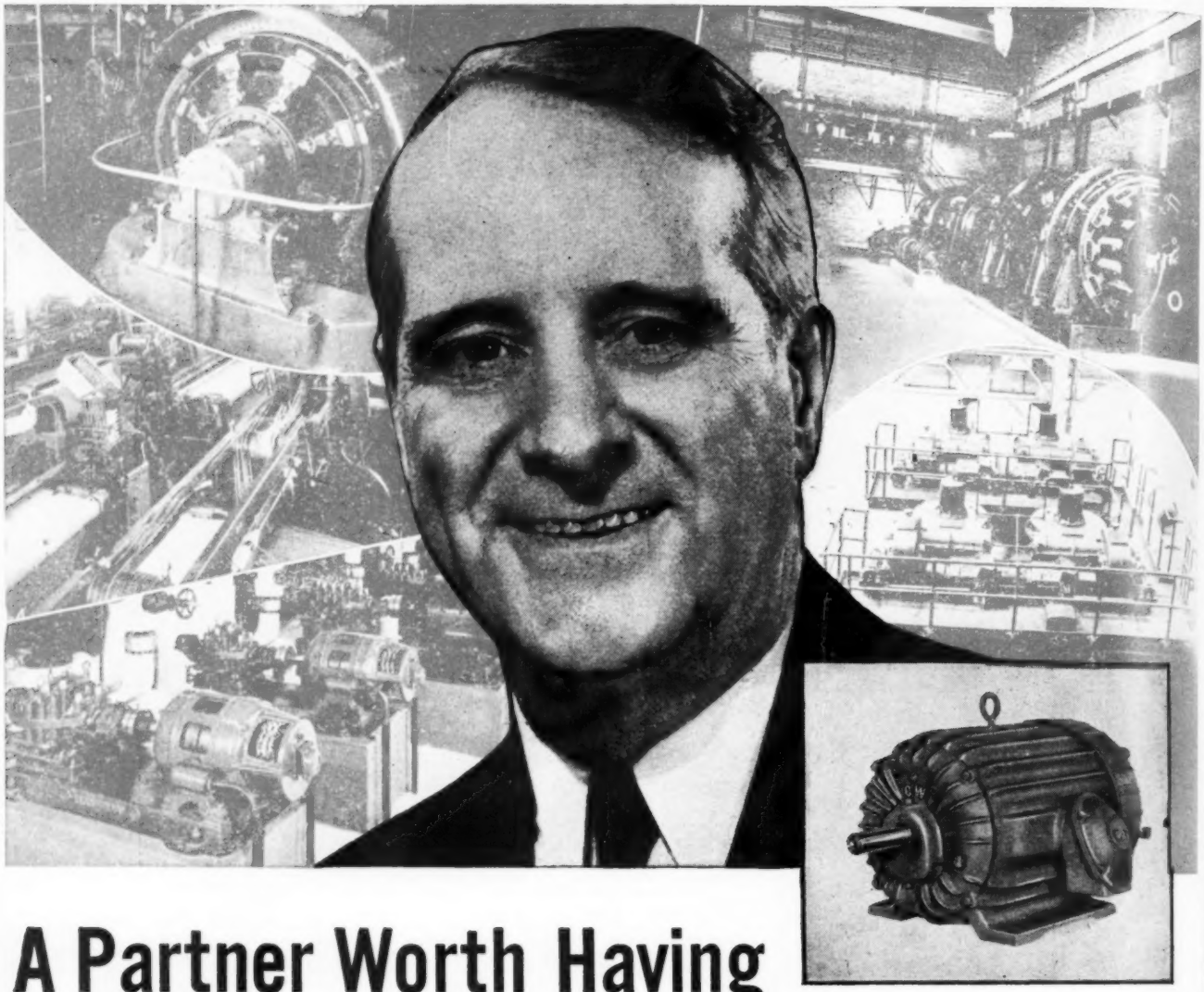
KELLOGG

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY

JERSEY CITY, NEW JERSEY • 225 BROADWAY, NEW YORK 7, N. Y.

Representatives: LOS ANGELES: 609 SOUTH GRAND • TULSA: PHILTOWER BLDG.



A Partner Worth Having

YES, THE CROCKER-WHEELER field engineer has an ear to the ground and an eye to the future. Not a miracle man, but thoroughly educated in engineering and with years of experience in the application of motors and generators.

Some men on our staff took part in the design and installation of the first steel mill motor . . . others installed the first motors geared to machine tools . . . still others worked on the first motor for printing presses, the first for pumps.

One of our men will be glad to discuss with you any motor or generator problem. While your plans are still in the blueprint stage is the time when his assistance can be most worthwhile. Write, wire or call on us at our nearest office.

JOSHUA HENDY IRON WORKS

CROCKER-WHEELER DIVISION

ESTABLISHED 1856

AMPERE, NEW JERSEY

CROCKER-WHEELER Trade Mark Reg. U. S. Pat. Off. Motors-Generators

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • ST. LOUIS • WASHINGTON • LOS ANGELES

Crocker-Wheeler Products

SQUIRREL CAGE MOTORS | WOUND ROTOR MOTORS | DIRECT CURRENT MOTORS | GENERATORS | FLEXIBLE COUPLINGS

WE REPEAT . . .

In Many Cases, It's Cheaper To Generate Your Own Electric Power Than To Buy It.

A Power Tale of Four Cities
SKINNER ENGINE COMPANY ERIE, PA.
Supplying Dependable, Economical ELECTRIC POWER for Industry
SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES
SKINNER ENGINE COMPANY ERIE, PA.
MORE PROOF
SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES
SKINNER ENGINE COMPANY ERIE, PA.
These Companies Don't Buy Electric Power They Generate Their Own, with
SKINNER "Universal Unaflow" STEAM ENGINES
SKINNER ENGINE COMPANY ERIE, PA.
Practically Every Industry
SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES
SKINNER ENGINE COMPANY ERIE, PA.

HERE'S PROOF . . .

DURING the past few months the accompanying advertisements have appeared in various technical publications. These have shown some of the many industrial plants and institutions in which large savings have been made, in comparison with the cost of purchased power, by generating electric power with "Universal Unaflow" steam engines, and utilizing the exhaust steam for building heating or process purposes.

If you are now purchasing power and are using low pressure steam, during the heating season or the year 'round, for building heat or processing, consult with us. We can undoubtedly cite similar cases in your particular industry where Skinner "Universal Unaflow" engines have paid for themselves out of savings. Our Research and Engineering Departments are available now to discuss your power costs for the future.

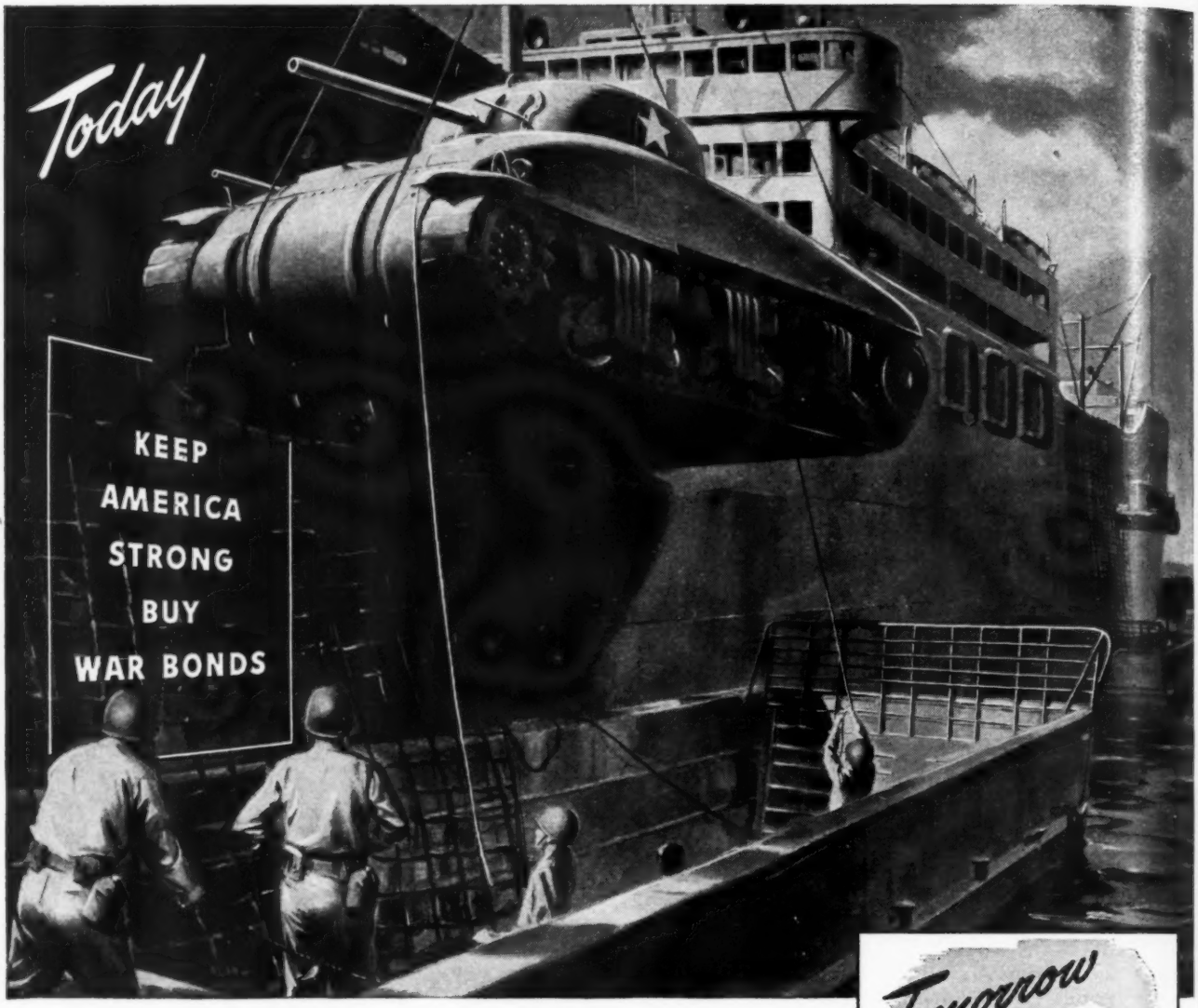
Some Users of "UNIVERSAL UNAFLOW" Engines

Hotels, Clubs	Food Products	Printing, Publishing
Schools and Colleges	Ice & Cold Storage	Paper, Paperboard
Hospitals, Homes	Mining	Laundries, Cleaners
Public Institutions	Chemical, Ordnance	Oil Refineries
Department Stores	Drugs and Soaps	Stone and Brick
Office Buildings	Machinery Mfrs.	Gas Plants
Railroads	Textiles	Rubber
Meat Packing	Leather Products	Glass
Dairies	Furniture & Woodworking	Bakeries
Breweries	Cotton Oil Mills, Gins	Tobacco
	Municipal Water & Electric Plants	

Back The Attack
Buy War Bonds

For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY ERIE, PA.



WHEN THERE'S WORK TO BE DONE —IN WAR OR PEACE

YOU will find GM Diesels hard at work in every theater of the war. They power massive tanks moving into battle, heavy trucks in endless supply lines, tractors to clear landing fields, landing and assault boats, big submarines and fast subchasers in home and in foreign waters.

In every respect, these GM Diesel Engines are living up to all that was predicted for them—and more. In many instances they are doing an even greater variety of jobs than they were designed for. They are standing up under conditions that couldn't possibly have been foreseen.

When the war is over, GM Diesels will be ready to serve the peace as they are serving in war. With this difference: expanded production facilities, together with improvements and refinements in design and construction, will make them even more available for use—more capable of reliable, low-cost performance.

GM Diesels will be on hand to show that they can do an even bigger job in America's trucks. Simple in mechanical construction; sturdily and precisely built; economical in operation and upkeep, GM Diesels will prove as indispensable in peace as they are proving vital in war.

GM
GENERAL MOTORS
DIESEL POWER

ENGINES..15 to 250 H.P...**DETROIT DIESEL ENGINE DIVISION,** Detroit, Mich.

ENGINES..150 to 2000 H.P...CLEVELAND DIESEL ENGINE DIVISION, Cleveland, Ohio

LOCOMOTIVES.....ELECTRO-MOTIVE DIVISION, La Grange, Ill.

Official U. S. Navy Photo

Violent Sea Action!

"Sure Kill" of a Nazi sub is depicted in this remarkable close-up of a U.S. bomber attack against a Nazi wolf pack. One bare-legged Nazi stands in awe as another ducks. Arrow points to depth bomb about to hit water.

Buy more War Bonds and help kill the enemy wolves!

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

Photo at left shows a set of Garlock CHEVRON packing and a single Chevron ring. Chevron is one of the many Garlock packings being supplied to the U.S. Armed Forces and war industries.

GARLOCK

. . . . . YOU MAY HAVE TO TRUST YOUR BOILER TO INEXPERIENCED HELP . . . .

CASH STANDARD AUTOMATIC COMBUSTION CONTROL *Systems*

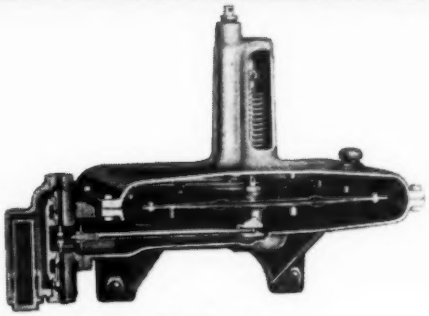
. . . remove all guess-work and manual error . . .

Keep your boiler room up to highest operating standards — save waste in fuel — get more steam — cut maintenance. Get all these results with the least in attendance requirements. Even though you must have inexperienced help you can still boost your boiler room performance.

CASH STANDARD Automatic Combustion Control gives you CORRECT FUEL FEED . . . you save coal, oil, or gas — PROPER AIR SUPPLY . . . you burn fuel economically — CONSTANT OVER-FIRE DRAFT . . . you prevent undue stack loss.

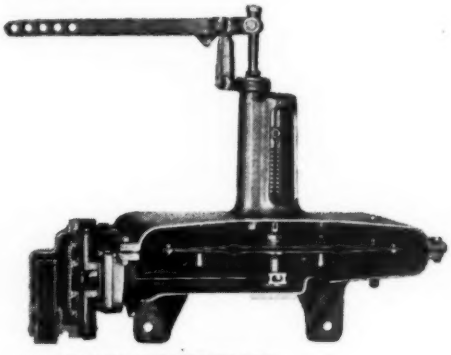
All of the units that comprise the complete system are available in numerous variations. Therefore, you can select combinations of these units to best serve your particular needs, whether you have a stoker, pulverizer, oil, or gas-firing equipment on your boilers.

To get details on the application of these units, whether you burn coal, oil, or gas, send for a copy of Bulletin No. 300.



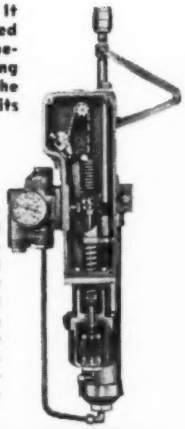
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

Why is this Taylor Recording Thermometer Like the Father of Our Country?

YOU'VE guessed it. George Washington couldn't tell a lie—and neither can a Taylor Mercury-Actuated Recording Thermometer! The reason is Taylor "Accuratus" Tubing—a special, precision-bore, all-welded tube system that insures accurate temperature recordings at a central control panel—as far as *100 to 200 feet away from the bulb!*

This just wasn't possible with ordinary connecting tubing. A hot or cold zone along the way could make the whole recording worthless. But Taylor Accuratus Tubing has a special alloy wire inside, with a coefficient of expansion so related to the tubing and the mercury that any variations in temperatures along the tubing are counteracted on the spot! The result is Accuracy.

Furthermore, a mercury-actuated system gives you the exclusive advantage of short ranges with open uniform chart graduations anywhere within the limits of —40° to +1000°F.

Why not start planning now to install Taylor Recording Instruments as soon as the war is over? Your Taylor Field Engineer can show you a wide variety of connecting tubings and bulb and well constructions, including the famous Taylor "Thermospeed" separable well construction. Write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, flow, humidity, and liquid level.*

ARMY E NAVY

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

★ KEEP ON BUYING U. S. WAR BONDS AND STAMPS ★

Cranking a Diesel requires

SPEED *and* POWER

Exide has both

AN Exide Battery maintains its high voltage and power to insure the cranking *speed* required to start a Diesel engine even at extremely low temperatures. Hot or cold, you can depend on your Exide for faster cranking.

Exides are designed and built for long-life and ease of maintenance. They are always dependable and durable. But, even the finest and longest-lasting battery must be given care, especially in war-time. Guard your Exides to make them last longer. You've *Bought to Last.* Now *Save to Win.*

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

BUY TO LAST
SAVE TO WIN

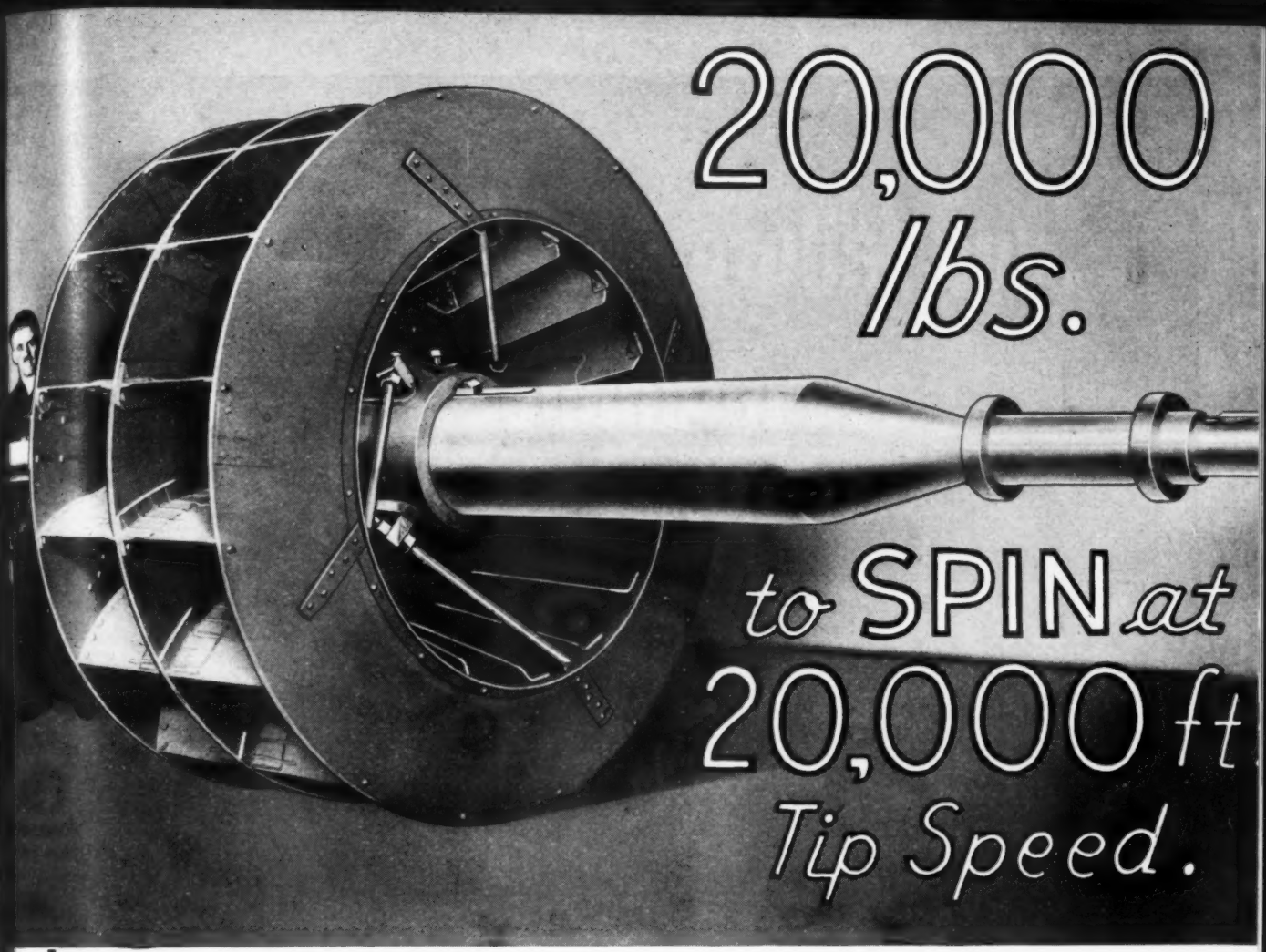
Follow these simple rules to make your batteries last:

1. Keep adding approved water at regular intervals. Most local water is safe. Ask us if yours is safe.
2. Keep the top of the battery and battery container clean and dry at all times. This will assure maximum protection of the inner parts.
3. Keep the battery fully charged—but avoid excessive over-charge. A storage battery will last longer when charged at its proper voltage.
4. Record water additions, voltage, and gravity readings. Don't trust your memory. Write down a complete record of your battery's life history. Compare readings.

If you wish more detailed information, or have a special battery maintenance problem, don't hesitate to write to Exide. We want you to get the long-life built into every Exide Battery. Ask for booklet Form 2399.

ARMY E NAVY

Exide
BATTERIES
FOR CRANKING
DIESEL ENGINES



Today's induced draft fan rotors with their high WR^2 require heavy duty construction throughout, heavy forged steel shafts, water-cooled bearings, and perfectly balanced rotor and shaft assemblies.

Buffalo engineers developed stiff blade designs coupled with center plate and tapered flange construction that will withstand very high tip speeds, welded steel wearing strips, and thrust collars turned from the solid steel shaft forging. Buffalo Induced Draft Fan rotors are built by men who have specialized in this type of fabrication. The finished job is balanced to a hair—and ready to deliver twenty-four hour service. Your power plant may not require draft fans with rotors as large as the one shown here—but whatever your requirements—why not have the best fan equipment obtainable? Let Buffalo engineers make recommendations.

ARMY E NAVY

Buffalo"
"First For Fans"

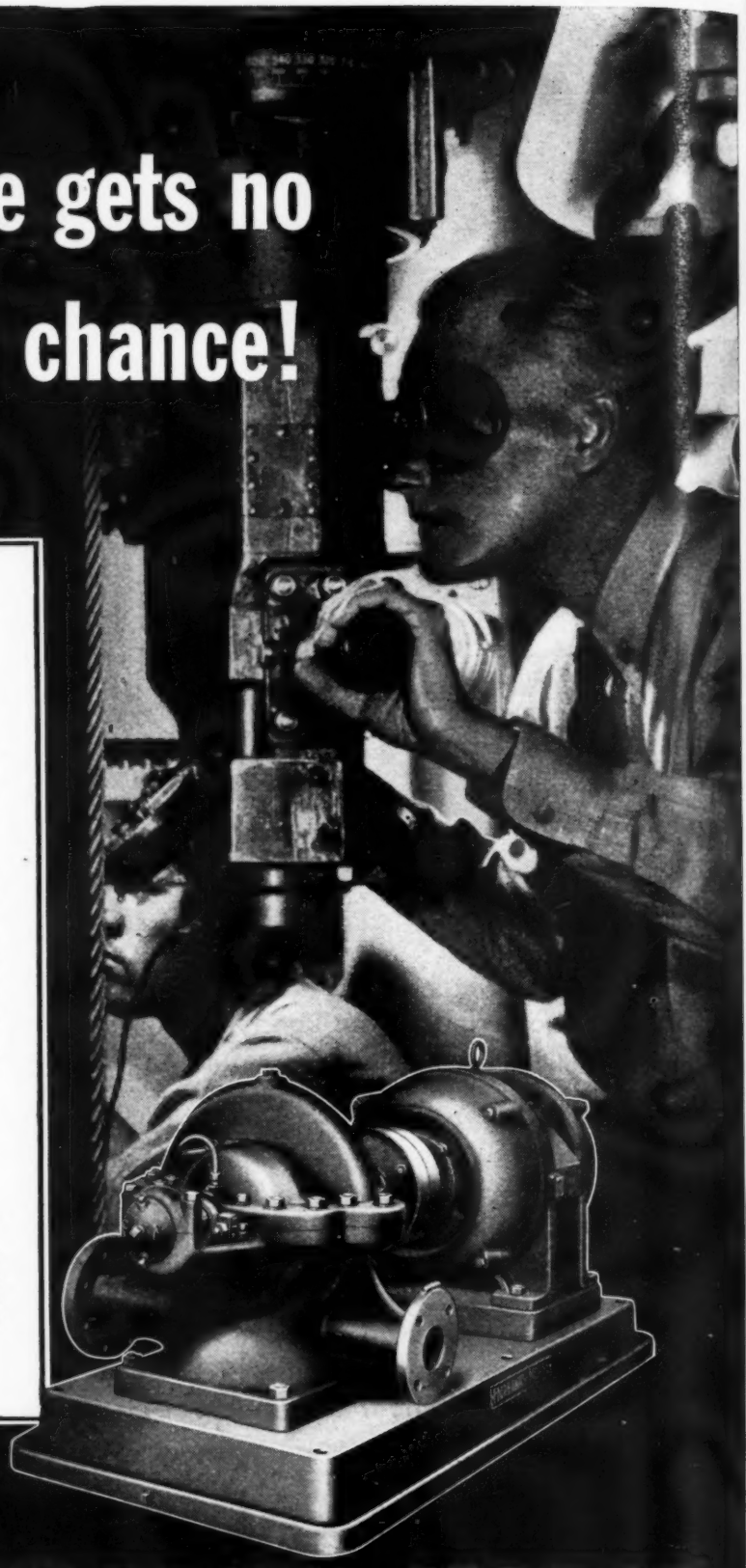
BUFFALO FORGE COMPANY

488 Broadway, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Forced and Induced
DRAFT FANS

...and failure gets no second chance!



"Surface!" With that command life itself hangs in the balance . . . depends upon pumps . . . reliable and efficient pumps that dare not fail *once!* It's a critical moment at any time . . . on any submarine, that demands the highest standards of perfection in pumping equipment.

That's why Fairbanks-Morse Pumps are used in United States submarine service. You can rely on Fairbanks-Morse Pumps . . . can know in advance that their mechanical superiority assures you dependable, economical operation now and for years to come.

For consultation without obligation, write Fairbanks, Morse & Co., 213 Fairbanks-Morse Building, Chicago 5, Illinois.

Fairbanks-Morse Centrifugal Pumps

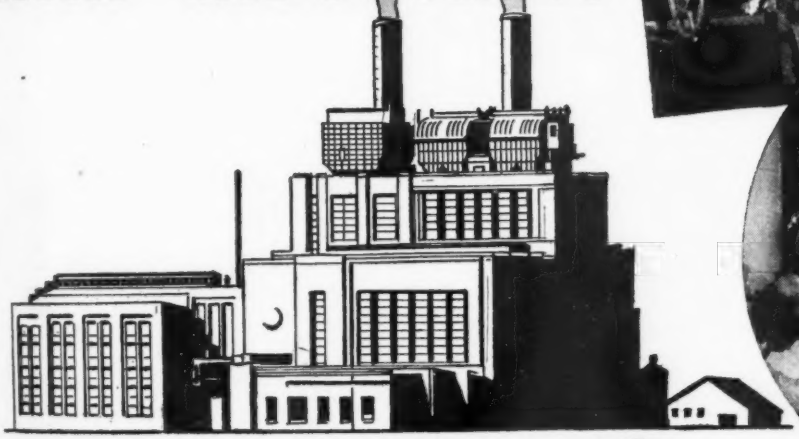
A complete "family" of single-stage, split-case pumps for low, moderate, medium, and high heads, is described in Bulletin 5810D. Many other bulletins available on other types.

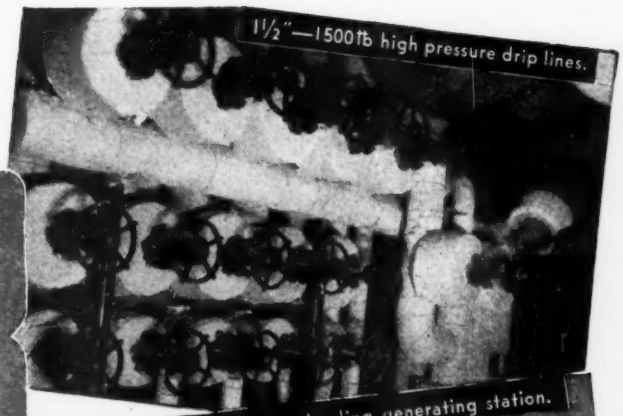
FAIRBANKS-MORSE

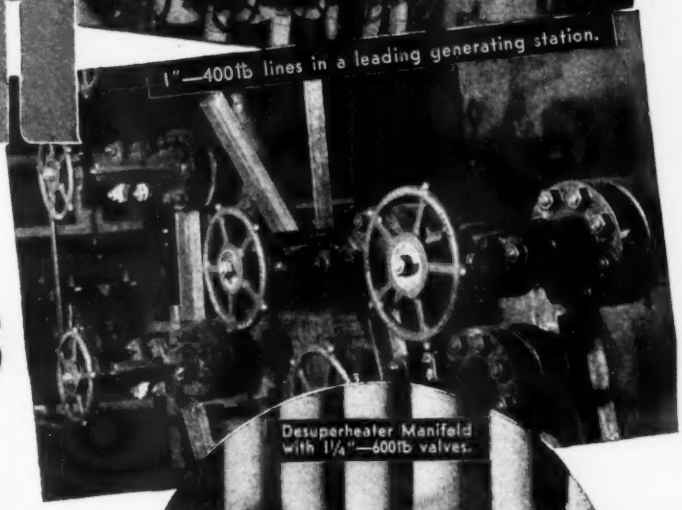
DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
WATER SYSTEMS
SCALES
STOKERS
FARM EQUIPMENT
RAILROAD EQUIPMENT

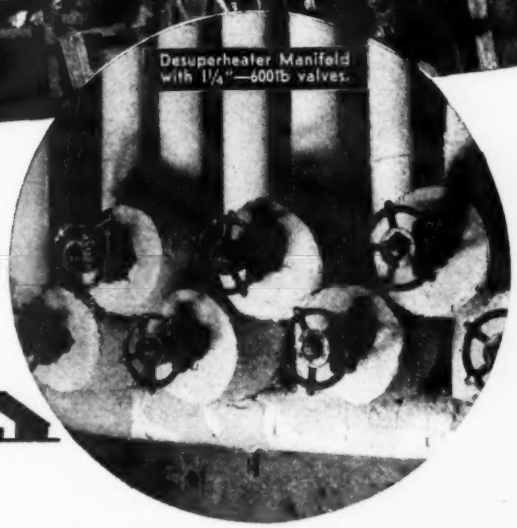
Pumps

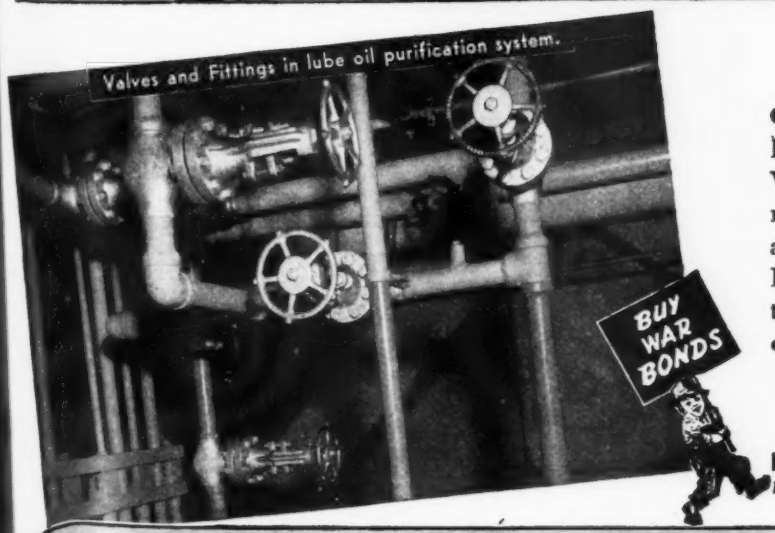
Uninterrupted
POWER
for
WAR INDUSTRIES











● **SAFE and SURE control of vapors and liquids in steam generating plants serving our War Industries is dependent on piping materials having an inherent "plus" of strength and toughness. *Drop Forged Steel* Valves, Fittings, and Flanges made by Vogt continue to play a vital part in the smooth, efficient operations of America's leading power plants.**

Catalog F-8 is the *drop forged steel* Valve and Fittings Blue Book.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky
Branch offices: New York, Philadelphia, Cleveland, Chicago, Dallas.

Vogt DROP FORGED STEEL VALVES, FITTINGS & FLANGES

These Men

Are Hard to Please!

The men who inspect Globe pressure tubes have exacting ideas on how a steel tube should "measure up." They rigidly inspect all tubes, demanding that they be strictly within tolerance specifications. Wall thickness and outside diameter are carefully gauged. And, while in process and after completion, Globe tubes are subjected to all hydrostatic pressure, flanging, crushing and other tests that may have been specified. Globe pressure tubes are thoroughly annealed for uniform ductility and strength in the latest and most advanced type of continuous annealing furnace. Made from aluminum killed steel, fine in grain, and superior to silicon killed steel for pressure tube service, Globe tubes are right for rolling-in, beading, and flaring operations. They are unusually resistant to fire-cracking and splitting.

EXTRA CARE IN THE MAKING

is standard procedure with Globe Boiler and Pressure Tubes. Modern high-temperature, high-pressure service proves the value of such extra precautions to meet today's extra demands. Globe's insistence on the most severe standards

MEANS AN EXTRA MARGIN OF SAFETY IN SERVICE!

GLOBE TUBES

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES
★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL *Tubes*

5006

GLOBE STEEL TUBES CO., *Milwaukee, Wisconsin, U.S.A.*

A LESSON IN WATER COOLING

(Write for this complete series of "Lessons")

HOT AIR RECIRCULATION

"Hot air recirculation" is an undesirable condition which occurs at intervals or continuously in those mechanical draft cooling towers not properly designed to prevent it. It is the re-entry, into the tower's fresh air intakes, of discharged air which is heat-laden from previous passage through the tower.

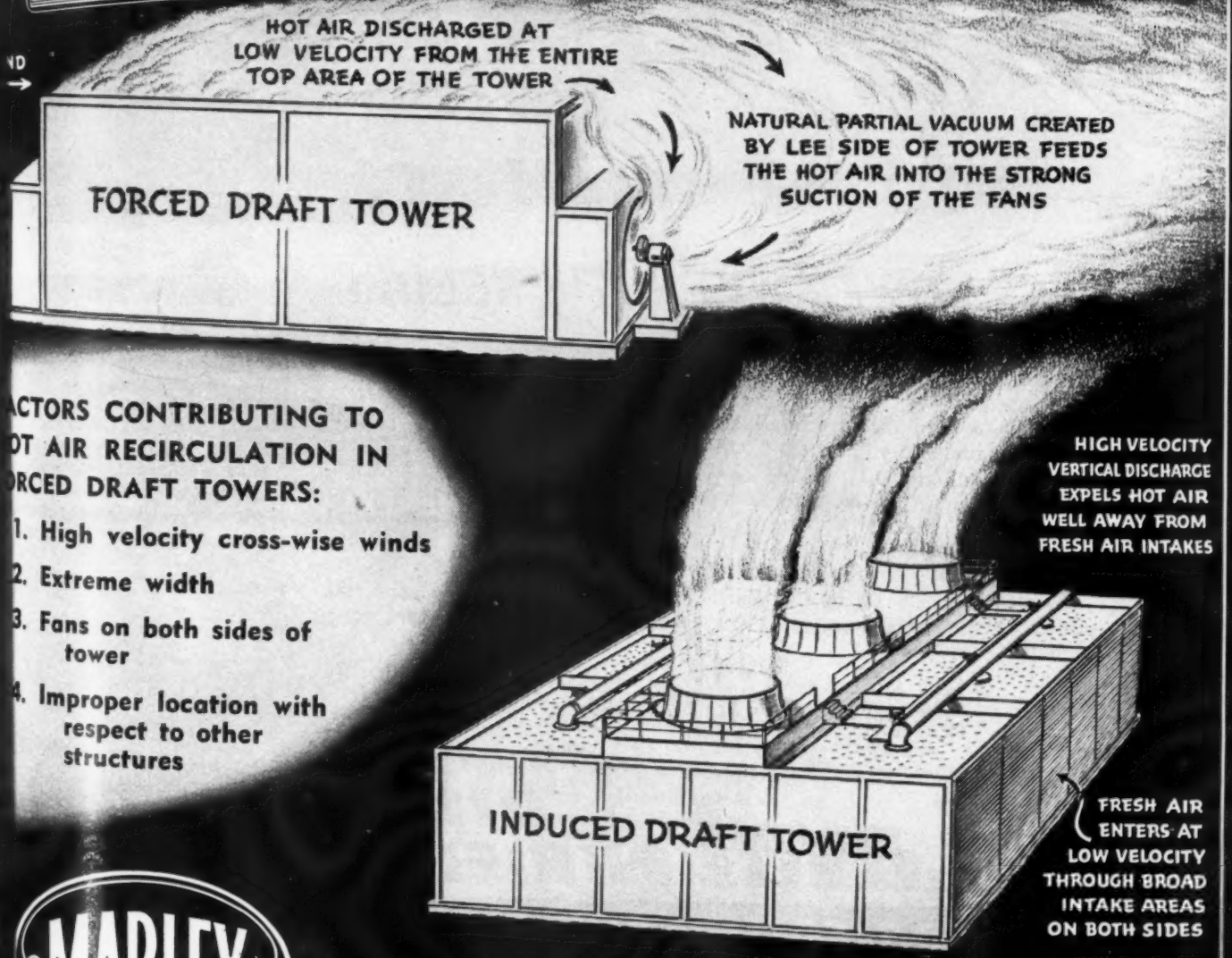
The net result of recirculating hot used air is to increase the wet bulb temperature and total heat content of the entering air. Its effectiveness as a cooling medium is thus reduced, causing the water temperatures to rise.

Recirculation of hot air increases water temperatures from a fraction to as much as 6 or 7 degrees in extreme cases. The following example is typical of the effect of recirculation upon cooling tower performance and investment:

	Performance as Designed	Performance with Recirc.
Hot water temperature	98 F	100.0 F
Cold water temperature	80 F	82.0 F
Wet Bulb temperature	73 F	75.5 F
Loss of tower effectiveness	0%	15%
Loss of investment	0%	15%

This negative feature of mechanical draft cooling towers is confined almost entirely to the forced draft type, particularly those having large fans and great width. The low discharge velocity of the hot used air leaving the broad top area of the forced draft tower permits it to be easily blown, by external winds, into the suction of the forced draft fans.

The induced draft type of cooling tower, with fans discharging vertically at great velocity, expels the hot used air high into the atmosphere and away from the fresh air inlets.


HOT AIR DISCHARGED AT LOW VELOCITY FROM THE ENTIRE TOP AREA OF THE TOWER
NATURAL PARTIAL VACUUM CREATED BY LEE SIDE OF TOWER FEEDS THE HOT AIR INTO THE STRONG SUCTION OF THE FANS
FORCED DRAFT TOWER
ACTORS CONTRIBUTING TO
OT AIR RECIRCULATION IN
RCED DRAFT TOWERS:
1. High velocity cross-wise winds
2. Extreme width
3. Fans on both sides of tower
4. Improper location with respect to other structures
HIGH VELOCITY VERTICAL DISCHARGE EXPELS HOT AIR WELL AWAY FROM FRESH AIR INTAKES
INDUCED DRAFT TOWER
FRESH AIR ENTERS AT LOW VELOCITY THROUGH BROAD INTAKE AREAS ON BOTH SIDES

MARLEY COOLING TOWERS

THE MARLEY COMPANY INC.
KANSAS CITY, KANSAS

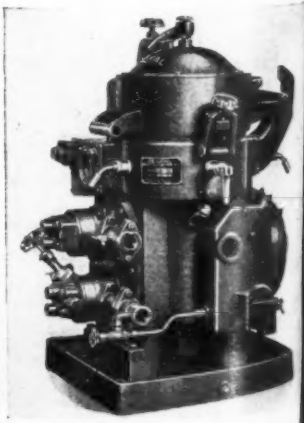
MEANS POWER WHEN IT'S NEEDED

BEARINGS of turbines and Diesel engines, working long hours under full load, need all the protection that high-grade lubricants can give. But even the best oil cannot give this protection unless it is continuously kept free from all the various types of impurities with which oils inevitably become contaminated in service.

The De Laval Oil Purifier keeps oil clean — continuously and unfailingly — instantaneously removing by centrifugal force the various materials that cause oil to lose its lubricating ability. Thus, De Laval purification enables oil to provide a maximum of protection to moving parts and permits the oil to be safely used over long periods.

There is a De Laval Oil Purifier and system for every size and type of prime mover. In writing for further details please state your particular problem.

. Bowls of the De Laval Oil Purifiers are of the "constant efficiency" type —the degree of purification is not affected by the removed sediment, which accumulates outside of the zone of separation.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York, 6 427 Randolph St., Chicago, 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco, 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

De Laval OIL PURIFIERS

FOR LUBRICATING AND FUEL OIL

A LIQUID GUN

THAT IS FIGHTING ON THE HOME FRONT

COFFIN—*Steam Turbine* CENTRIFUGAL PUMPS

Feed The Nation's Boilers

Coffin Steam Turbine Centrifugal Pumps are projecting feedwater into the boilers of war plants, locomotives and ships on the home front so that the guns at the battle front can project shells.

No piece of ordnance is manufactured with more precision. All wearing parts are renewable and 100% interchangeability is maintained.

If you require a pump to win the battle of production or transportation, send for your copy of descriptive bulletin.

RANGE—

To 500 G.P.M. Delivery
To 750 P.S.I. Pressure.

Mail the Coupon

THE J. S. COFFIN, JR., COMPANY
ENGLEWOOD, NEW JERSEY

Please Send Descriptive Bulletin 1-22

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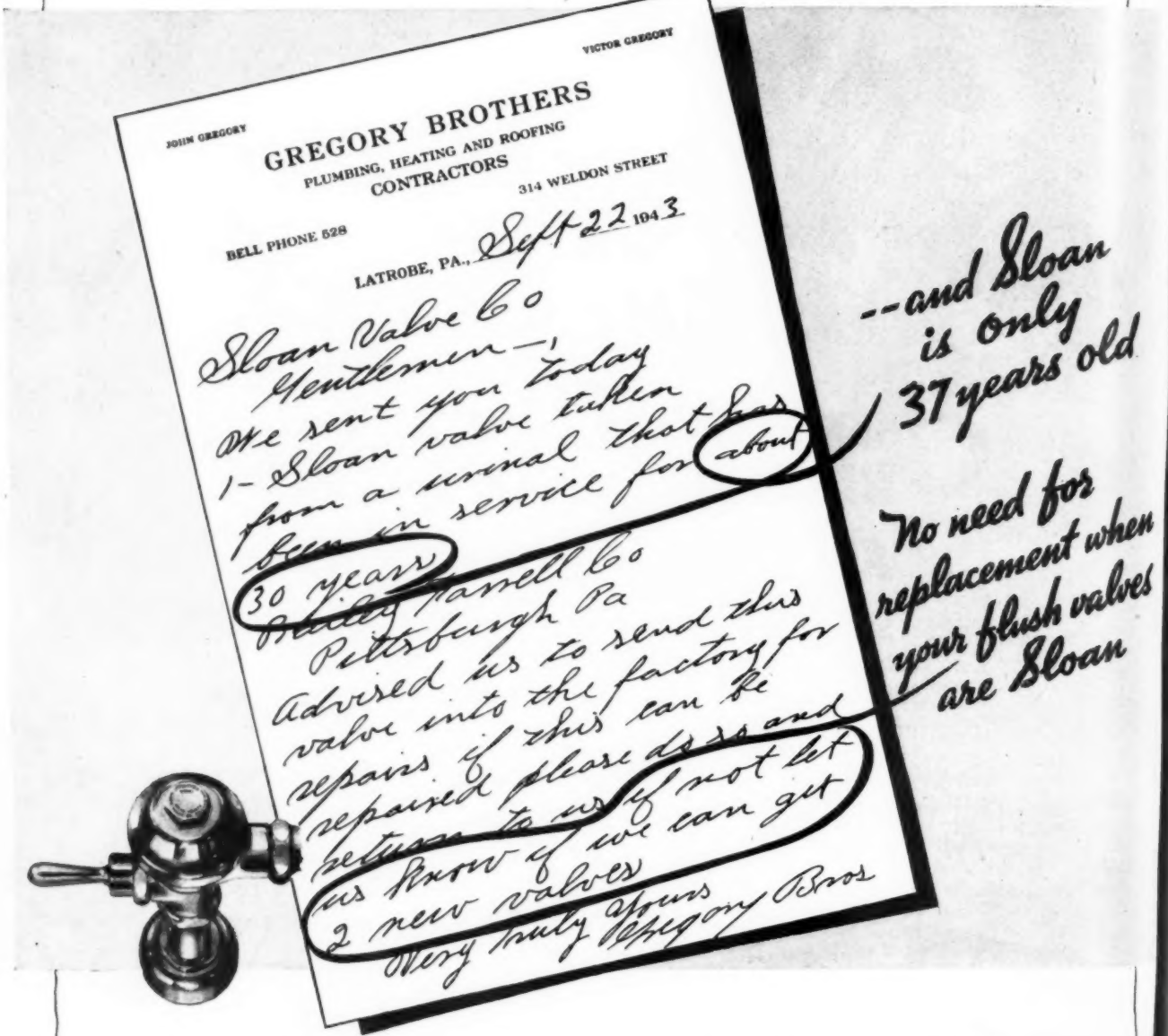
COMPANY _____

ADDRESS _____

P.W.

SLOAN VALVES' WARTIME ECONOMY BORN MANY YEARS AGO



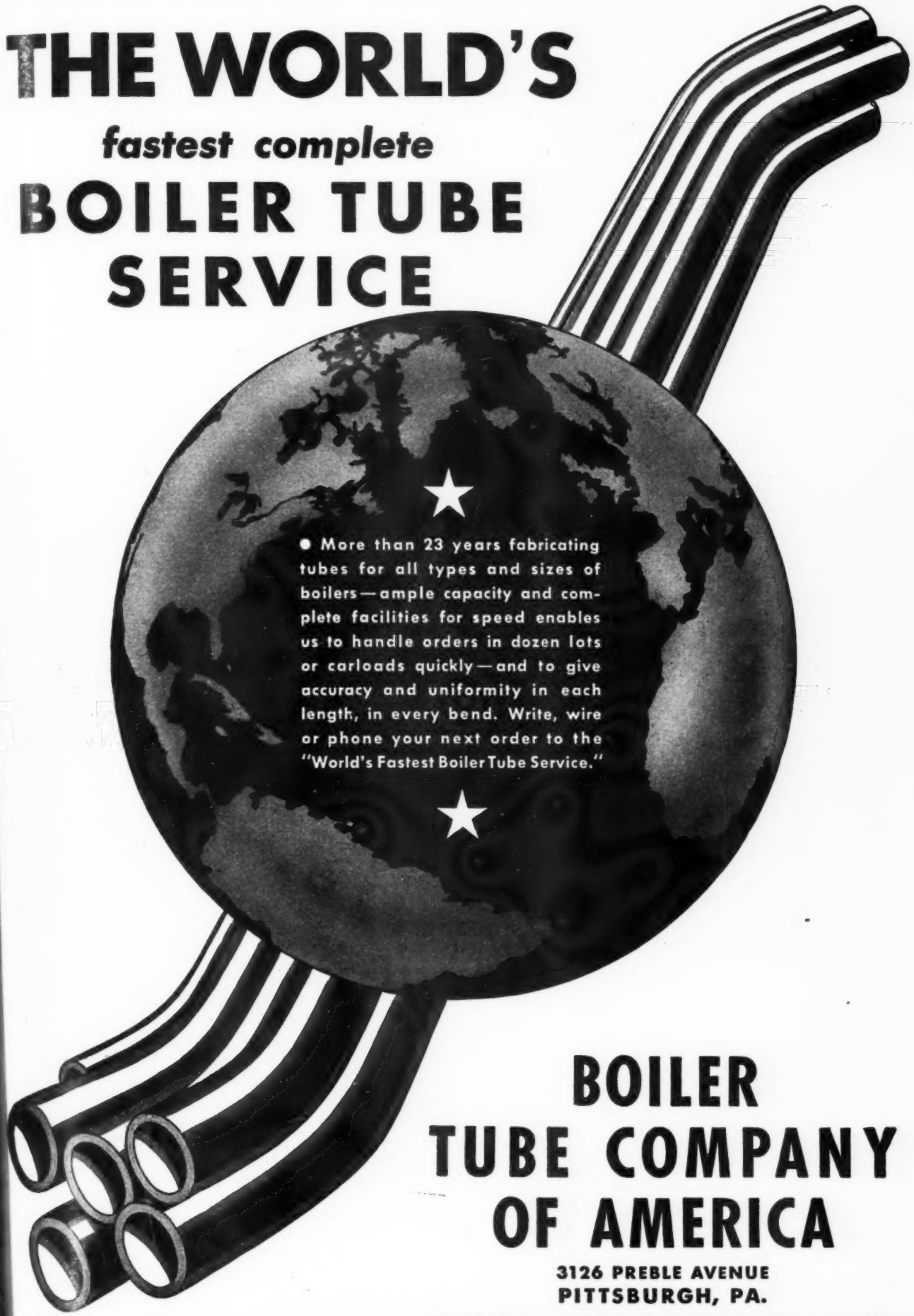
The above letter tells its own story—a story typical of the unequalled performance of Sloan Flush Valves. Of course, Gregory Brothers' Flush Valve was repaired and is again as good as new and should give many more years of trouble-free service.

Throughout fighting America the advantages of Sloan superiority are multiplied by millions—and with records of performance such as this singular one above, it is little wonder why there are more Sloan Flush Valves installed than all other makes combined.

SLOAN VALVE COMPANY

4300 WEST LAKE STREET • CHICAGO, ILLINOIS

THE WORLD'S *fastest complete* BOILER TUBE SERVICE



• More than 23 years fabricating tubes for all types and sizes of boilers—ample capacity and complete facilities for speed enables us to handle orders in dozen lots or carloads quickly—and to give accuracy and uniformity in each length, in every bend. Write, wire or phone your next order to the "World's Fastest Boiler Tube Service."

BOILER TUBE COMPANY OF AMERICA

3126 PREBLE AVENUE
PITTSBURGH, PA.

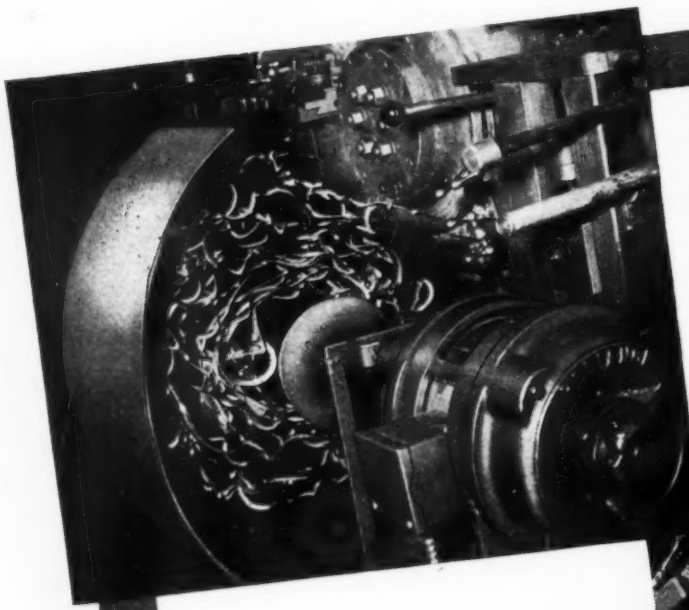
PITTSBURGH • NEW YORK • PHILADELPHIA • CHICAGO

FRED S. RENAULD & COMPANY, Los Angeles

Seamless or Welded

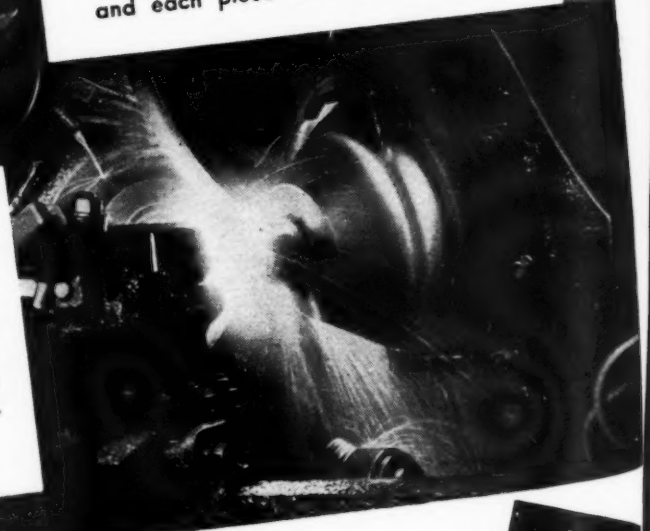
IT'S THE STANDARD B&W QUALITY

The use of quality steel in the manufacture of Babcock & Wilcox Boiler Tubes—whether seamless or welded—is of major importance in this day of high-pressure, high-temperature boiler installations. Seamless tubes are produced by a piercing operation which also includes a forging action. The electric resistance method welds flat stock into tubes of uniform wall thickness, maximum strength and excellent finish. These characteristics of all B&W Tubes are your guarantee of SAFETY.



← WELDING PROCESS

In the electric resistance welding method the flat stock, accurately gauged and trimmed, is first formed into tubular shape. In the next operation pressure rolls applied beneath the electrodes force the heated tube edges together to form a weld. All B&W Tubes—seamless or welded—are finished to gauge accuracy and each piece is individually tested.



SEAMLESS PROCESS →

The illustration shows the piercing mill in operation. The round bar is forced over the conical piercing point. This operation also performs a forging action which strengthens the metal structure.

★ BUY MORE WAR BONDS! ★

THE BABCOCK & WILCOX TUBE CO.

SEAMLESS TUBE DIVISION • *WELDED TUBE DIVISION*

BEAVER FALLS, PA. **ALLIANCE, OHIO**

TA-1274

COMPRESSORS AT WAR

Compressed Air . . . vital power in practically all industries . . . power for air tools, to build airplanes, ships, tanks, trucks, locomotives . . . power for rock drills to mine the metals, rock, and coal, and build airfields, tank traps, roads, bridges . . . power to operate controls . . . to scavenge guns . . . for torpedoes . . . AIR POWER for so many jobs that cannot be done with any other form of power.

The source of this power – the heart of the system – is the Air Compressor. It must be the right size and design, efficient and reliable and driven by the most economical and convenient prime-mover – electric, steam, oil or gas engine.

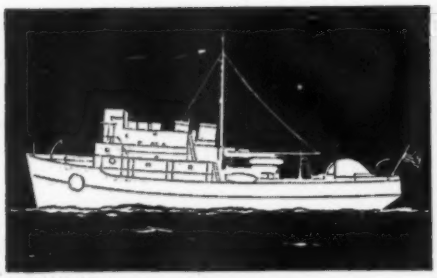
Compressed Gas . . . all-important to many great industries essential to victory – aviation gasoline, synthetic rubber, explosives, synthetic alcohol, refrigeration, helium, oxygen, hydrogen, refining – and, remember the thousands of miles of pressure pipe lines serving great industrial areas with gas power, heat, and light – pipe lines gathering natural gas for repressuring, recycling, and natural gasoline – gas which must be pumped by a Compressor.

Such machines call for the utmost in engineering ingenuity – designs and materials must meet very exacting conditions – pressures and temperatures reach terrific heights – such Compressors must not fail – they must be right.

★ These are only some of the reasons why Compressors are so vital – critical – to the war effort. The many developments taking place in making better Compressors for war will be available to all of our customers after peace is signed and Compressors again concentrate on the task of production for Commerce. Let our engineers discuss your problems with you.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

I-383



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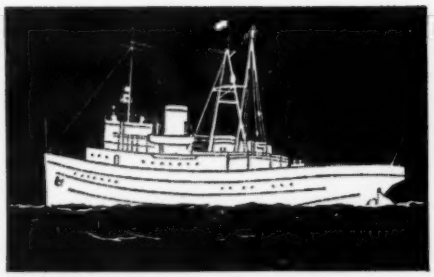

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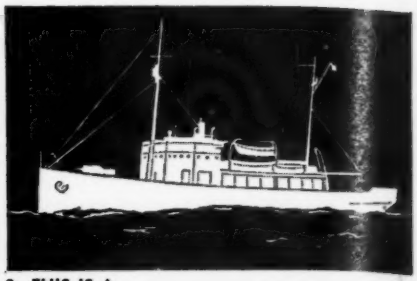

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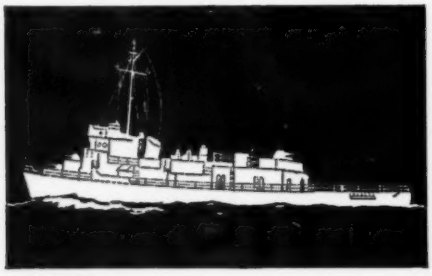

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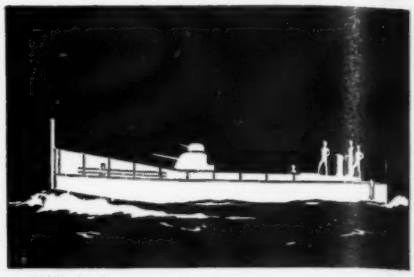

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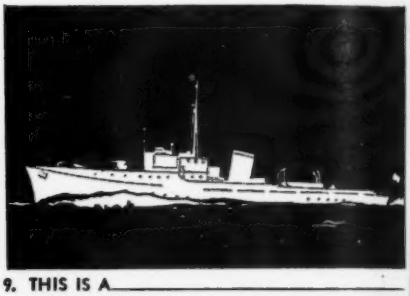

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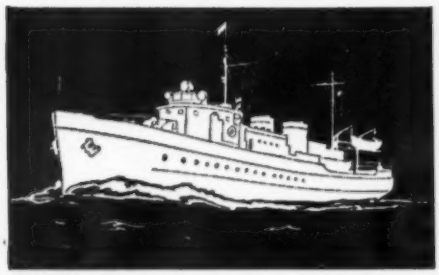

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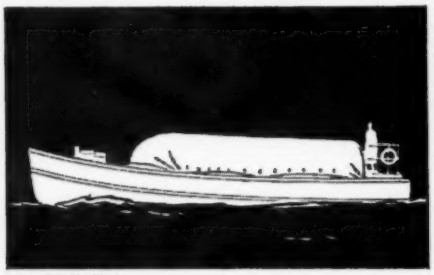

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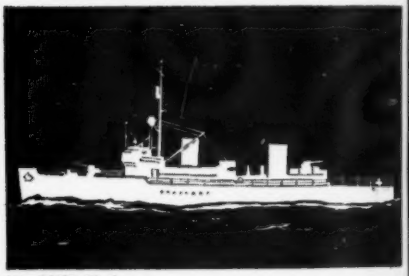

12. THIS IS A_____

How many can you identify?

These boats do the "leg work" for our fleet. Their jobs are not always spectacular—but each has a critical assignment in the blueprint for victory, none must fail at a moment of decision. That's why the Diesel engines in so many of them are lubricated with Standard of California's RPM DELO.

RPM DELO ends the costly annoyance of stuck rings in Diesels. It banishes fear of bearing corrosion, stops sludge and deposits, cuts wear to the thinnest minimum.

To double the interval between overhauls in your Diesels, to cut repair bills in half—switch to RPM DELO. No other Diesel lubricant combines its anti-oxidant, non-corrosive and detergent qualities. It's America's finest Diesel lubricant.

The ships illustrated are: 1. Coastal mine sweeper. 2. Tug. 3. Coast Guard cutter. 4. Submarine. 5. Destroyer escort. 6. Tank lighter. 7. Net tender. 8. Troop landing boat. 9. Submarine chaser. 10. Coast Guard patrol boat. 11. Launch. 12. Fleet mine sweeper.

ORDER RPM DELO FOR YOUR DIESELS

RPM DELO

RPM DELO is marketed under these names:

RPM DELO • Caltex RPM DELO • Kyso RPM DELO
Signal RPM DELO • Sohio RPM DELO
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CONCENTRATE

Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your vicinity

STANDARD OF CALIFORNIA

A SYMBOL OF COOPERATION

To the men and women of Thermoid, the Thermoid seal is more than just a trade mark and a product identification. It is a symbol of individual responsibility among all company employes: management, engineering, production and sales.

This concept of the Thermoid seal produces cooperation among employes. Every Thermoid employe realizes that his own business welfare directly depends upon the approval and acceptance of Thermoid Products by the user . . . that men and management who manufacture inferior merchandise also manufacture the elements of their individual failure.

The protection of this Thermoid seal is therefore recognized as the personal duty of every member of the Thermoid group. Uniformity in product manufacture, meticulous inspection, prompt and personalized attention to customers, and all of the other things that have made for consistent Thermoid progress are in large measure traceable to this concept of the Thermoid seal.

No matter what the uncertainties ahead Thermoid will continue to make the finest industrial products possible. 1944 finds Thermoid with the largest personnel and facilities in its history. We are confidently hopeful that during this year, we will have the opportunity of further demonstrating the cooperation symbolized in the Thermoid seal—the cooperation that has caused Thermoid customers to say:—*"It's good business to do business with Thermoid."*

★

THE THERMOID LINE INCLUDES: Transmission Belting • F.H.P. and Multiple V-Belts and Drives • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Sheet Packings • Industrial Brake Linings and Friction Products • Molded Hard Rubber and Plastic Products.

Thermoid Rubber

DIVISION OF THERMOID CO.
TRENTON, NEW JERSEY

It's Good Business to do Business with Thermoid

VICTORY IS MOVING OVER AMERICA'S POWER LINES!

Today, every kilowatt *counts* as never before. Total war calls for total POWER . . . a fact well recognized by America's power industry, which is performing a notable war service by stepping up production to an all-time high.

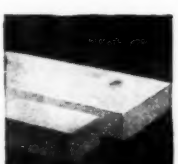
Carey HEAT INSULATIONS

● —perfected through years of research and experience—are providing efficient insulation service in many of the nation's largest public utilities, as well as in industrial power plants of every size. By reducing fuel consumption to a minimum, these durable Magnesia and Asbestos Insulations are making possible the utmost in kilowatt production at lowest operating cost.

● Whatever your needs, you can be sure of getting dependable service with CAREY Heat Insulations. Our nation-wide distribution and engineering organization is available at all times. Catalog mailed on request—address Dept. 16.

85% Magnesia
For High and Medium Pressure.

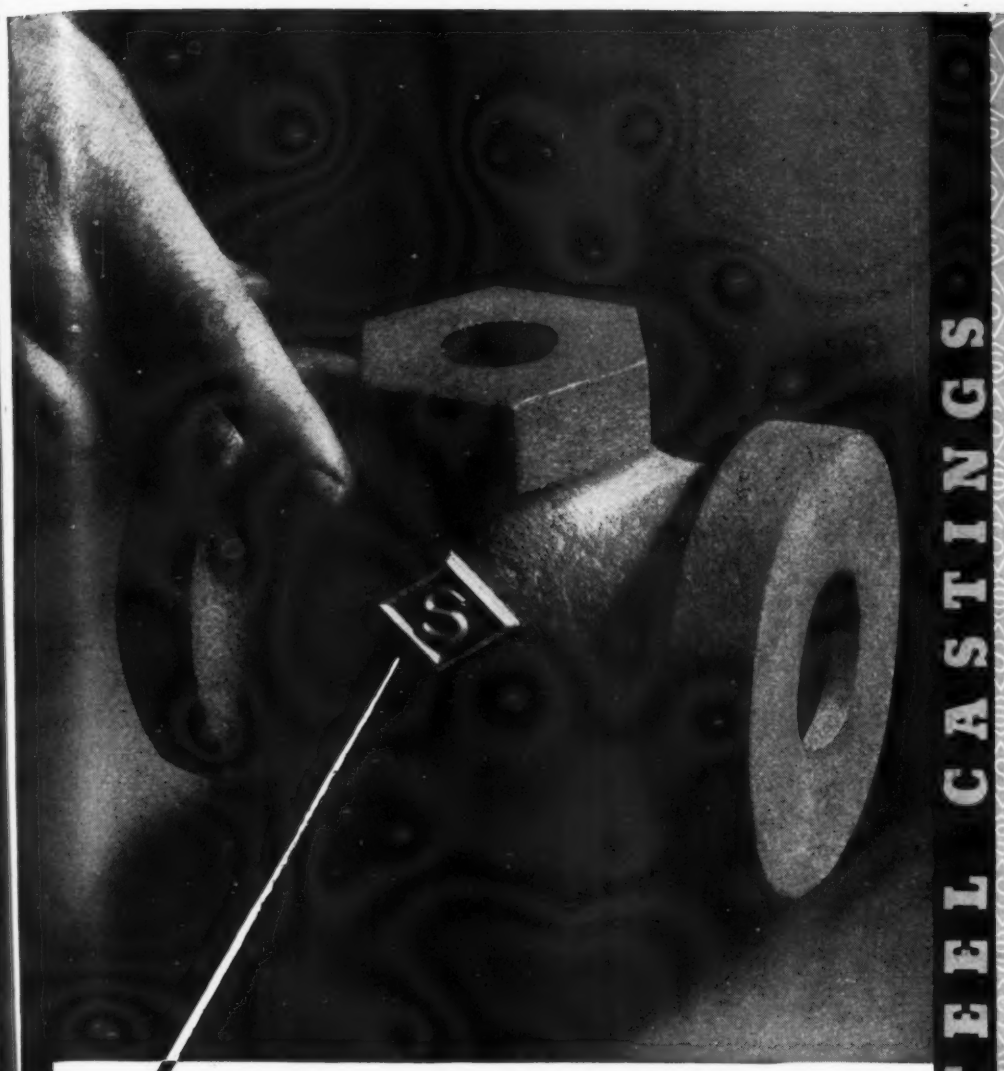
Combination Hi-Temp—85% Magnesia.



Hi-Temp Blocks
For Furnaces, Ovens, Kilns, etc.

Careycel Insulation
For temperatures up to 300°F.

THE PHILIP CAREY MFG. COMPANY
DEPENDABLE PRODUCTS SINCE 1873 ● LOCKLAND, CINCINNATI, OHIO
In Canada: The Philip Carey Company, Ltd. ● Office and Factory: Lennoxville, P. Q.



SIVYER STEEL CASTINGS

Worth Looking for...

When You Want Dimensional Accuracy

It's no accident that Sivyer castings are unusually true to dimensional specifications. Our foundry personnel know they'll be held accountable for sticking to very close tolerances. Our production set-up provides numerous dimensional tests and inspections for every casting. When you're looking for castings that are true to pattern, the Sivyer Ⓢ is worth looking for.

ARMY NAVY

SIVYER STEEL CASTING COMPANY

MILWAUKEE Ⓢ CHICAGO Ⓢ

In the Groove
THE DIFFERENCE SHOWS

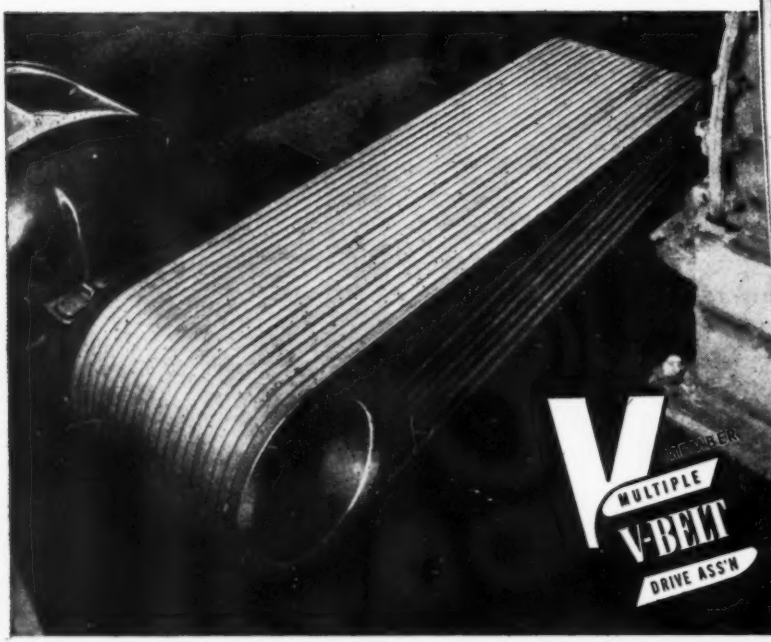
Wood's Sheaves are engineered to provide for a snug fit and maximum grip by the V-Belts. Grooves are precision machined, uniformly spaced and absolutely true, with side walls at proper angles. Then, the belts being full moulded, flexible and resilient, perfectly match the grooves so that the harder the pull the greater the wedging action of the belts in the grooves . . . and the higher the percentage of power transmitted. In fact, efficiencies often run as high as 98%.

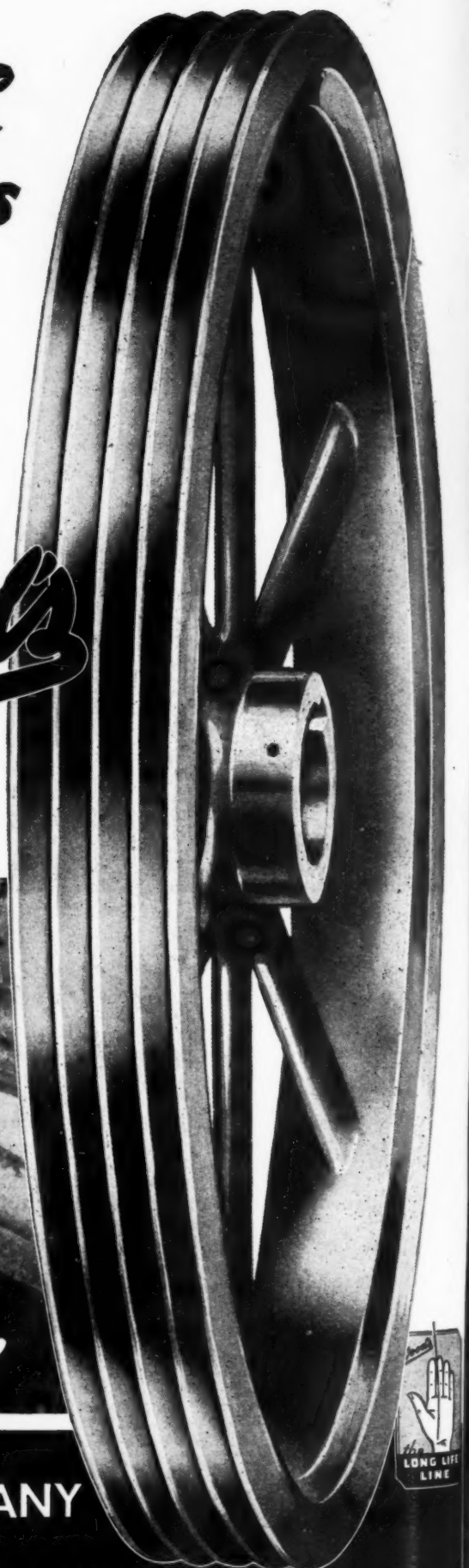
Let us give you full details about our line of nearly 2800 Wood's V-Belt Drives ranging from ¼ H.P. to 100 H.P. with a wide selection of center distances for each. Our 64 page V-Belt Drive Catalog will be sent on request . . . or ask your nearest Wood's Distributor about them.

EVERYTHING IN TRANSMISSION
Bearings • Collars • Clutches • Couplings
Contactors • Hangers • Pillow Blocks • Pulleys
V-Belt Sheaves and Complete Drives.

Wood's

V-BELT DRIVES





T. B. WOOD'S SONS COMPANY
CHAMBERSBURG, PA.

BRANCHES: 387-391 ATLANTIC AVE., BOSTON, MASS. · 94 PLANE ST., NEWARK, N. J. · 425 FIRST AVE., PITTSBURGH, PA.

MANHATTAN

CONDOR V-BELTS

Whipcord construction gives flexibility, strength and extreme lack of stretch.

OMOCORD

Homogeneous and cushioned Strength Members provide free flexing of Conveyor Belts over pulleys and easy troughing on idlers.

STRENGTH MEMBERS

. . . are the *SINEWS* of FLEXLASTIC* Rubber Muscles

Just as the sinews hold together and strengthen the muscles without limiting their freedom of movement, so MANHATTAN STRENGTH MEMBERS reinforce and strengthen the FLEXLASTICS*, at the same time that they enhance their flexibility and durability.

MANHATTAN STRENGTH MEMBERS are "engineered," each one for a specific service, fabricated and scientifically located in the precise area or section where they contribute the most to structural life and capacity—just as in engineering design of bridges or trusses. Members of suitable materials, correctly proportioned and treated, are properly placed with respect to all other component parts.

Examination of the diagram below of ordinary and Condor Compensated Belt illustrates clearly what correctly designed strength members accomplish in performance, longer life and notably lower ultimate cost of power transmission. It is an economy which extends beyond the belt itself, to bearing and machine and to uninterrupted production.

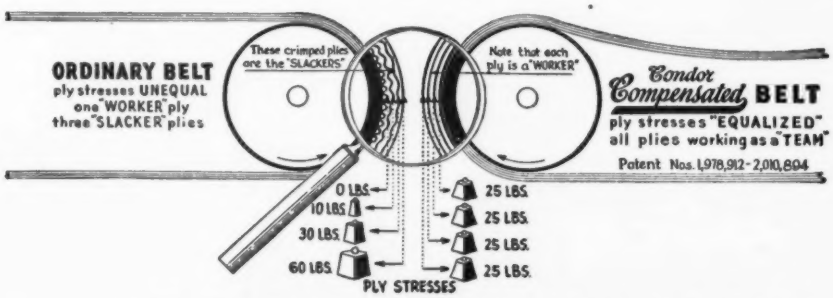
Similar advantages result from a long line of exclusive MANHATTAN developments, such as the Homocord principle for Conveyor Belts; Condor Whipcord Endless Belts with Extensible Tips; Condor Whipcord V-Belts; Homoflex Hose in air, water, spray and other types; MANHATTAN Fire Hose with Radio-Active Mildew-Proof Treated Jackets, and many others.

Condor PRODUCTS

veyor and
evator Belt
pensated Belt
smission Belt
elt
Hose
ractors Hose
Hose
draulic Hose
and Gasoline
ose
Blast Hose
m Hose

Suction Hose
Water Hose
Chute Lining
Launder Lining
Industrial Brake Blocks and Lining
Molded Rubber Goods
Rubber Lined Tanks
Rubber Covered Rolls

Abrasive Wheels
Bowling Balls



The term FLEXLASTIC is a MANHATTAN trade mark. Only MANHATTAN can make FLEXLASTICS.

st YEAR OF RESEARCH

The record of the first 50 years of plishment is the pledge for the second half-century HATTAN is now entering with research, testing, d inspection as a basic policy, so there may be un- continuity to its contribution to industry. It will be sound policy to keep with MANHATTAN.

P AHEAD WITH MANHATTAN

THE MANHATTAN RUBBER MANUFACTURING DIVISION
of RAYBESTOS-MANHATTAN, INC.
EXECUTIVE OFFICES PASSAIC, NEW JERSEY

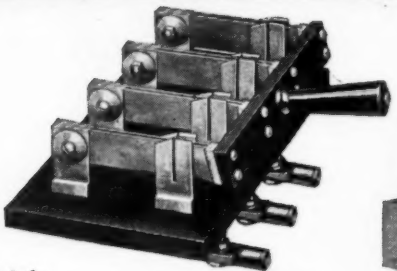
HEAVY DUTY CONSTRUCTION

Safety Switches

FOR PLANT and OFFICE

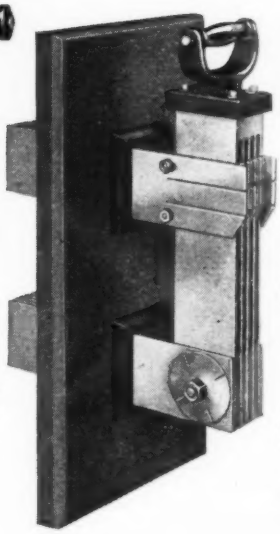
Knife Switches

(OPEN STYLE)



★ Type "A" Safety Switch, 60 amp., 3 pole, 230 volt fusible switch; only 9½" wide, 17½" long, 4¼" deep.

★ 200 amp., 4 pole, single throw, back connected, non-fusible knife switch.



★ 5000 amp. d.c. single pole, laminated stud knife switch.

THIS switch is of heavier design than the average, with all steel parts, extra heavy gauge, plated to be corrosion-resistant and all actuating parts case hardened. Extremely compact . . . small and narrow with no projections beyond width of box, it permits mounting where space is limited. With a (baked) finish both attractive and durable, the switch "fits" into office as well as plant locations . . . wherever good appearance and long service are important. Ask for Bulletin 1300.

LIKE the Safety Switch, this Type "A" Knife Switch is of heavy duty construction . . . jaws set into base blocks, securely riveted and sweated into place, all current carrying parts of electrolytic copper. Hinges and receptacles are of rugged construction. Another feature is the exceptionally generous contact area with laminated poles maintained under high pressure due to the clamping effect of multiple construction. Ask for Bulletin 1320.

THE ELECTRIC CONTROLLER & MFG. CO.

2700 East 79th Street

Cleveland 4, Ohio

★

Why are so many drives of all types being belted with .. GRATON AND KNIGHT "Research"?

...Because "Research" gives you

THE 3 BIG ADVANTAGES OF QUALITY LEATHER

MORE PRODUCTION, because leather's superior traction, which improves with age, means more power delivered . . . greater average machine production.

LESS MAINTENANCE, because leather has natural "give-and-take" to handle shock loads without undue strain on belt or equipment.

LONGER LIFE, because the tough, interlocking fibres of leather have high resistance to both surface wear and internal friction.

and

3 EXCLUSIVE FEATURES OF "RESEARCH" BELTING

MOST PRODUCTION, because "Research" currying, added to leather's superior traction, creates highest frictional surface. 3% more production guaranteed.

LEAST MAINTENANCE, because G&K's pre-stretching process removes non-elastic stretch, resulting in fewer take-ups. Tensile strength is also increased 15%.

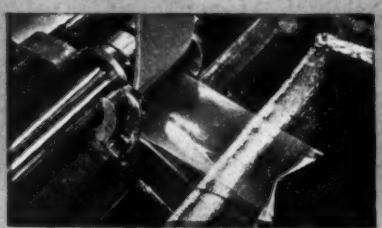
LONGEST LIFE, because precise, weight-controlled lubrication of fibres develops extremely long life. "Tension-Cementing" insures against ply separation.

YOU'LL GET AT LEAST 3% MORE PRODUCTION ...2 to 4 TIMES LONGER LIFE...ON LONG OR SHORT CENTERS

MORE PULLEYS ARE BELTED BY "RESEARCH" THAN BY ANY OTHER BRAND!

In G&K's currying process, the amount of grease worked back into the dry leather to give pliability and frictional surface is controlled by precise weighing — for more "built-in" pulley grip.

An exclusive method — pre-stretching according to hide characteristics — removes initial stretch and increases tensile strength — proved by Research performance in eliminating excessive take-ups.



Tension-Cementing — replacing hand methods — applies the cement with perfect uniformity while belt is under working tension — for most uniformly high adhesive strength ever obtained in belting.

GRATON & KNIGHT COMPANY

WORCESTER 4, GRATON AND KNIGHT MASS.

Graton & Knight is the only leather belting manufacturer with complete nation-wide service facilities. Branches in Chicago, Cleveland, Dallas, Detroit, Kansas City, Minneapolis, New York, Philadelphia, St. Louis, San Francisco; distributors in all industrial centers.

Look under "Graton & Knight" in Belting section of Classified Telephone Directory or THOMAS' REGISTER.

A New Type of Ship Follows Her ...with the Same Type of Diesel

Below is a picture of the U. S. Maritime Commission ship American Manufacturer. She is one of the C-1 vessels propelled by Busch-Sulzer Diesel engines. The C-1's are giving a good account of themselves, delivering war cargoes on fighting fronts the world over.

Now a new type of Maritime Commission vessel will carry the battle to the enemy—the C1-MAV-I. Busch-Sulzer is proud, of course, that its Diesel engines on C-1 ships made a reputation that has earned them the privilege of powering the new vessels. That reputation stems from nearly half a century of producing Diesel power noted for low operating cost, low maintenance cost and reliability. These factors will be offered to you when Victory ends our present schedule of 'round the clock production for the Army, Navy, Maritime Commission and high priorities only.

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY
SAINT LOUIS

★

★

★

★

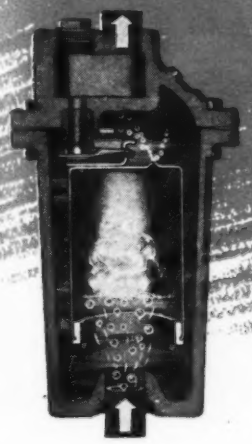
★

BUSCH-SULZER
ST. LOUIS

★

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

16 Armstrong traps save 800 gals. fuel oil per week in chemical plant



Armstrong traps on chlorobenzene stills, in phenol plant.

FILE 5-41 Chemical plants represent another industry which uses thousands of Armstrong inverted-bucket steam traps to save fuel, money, heating time, maintenance and manpower.

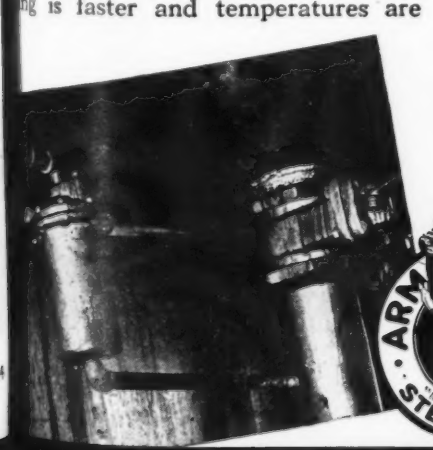
A typical example from our files is that of a chemical manufacturer in Iowa, which effected a cut in fuel consumption from 1,500 to 700 gallons a week by the installation of 16 Armstrong traps. The savings in fuel are $2,500 a year. In addition, the management reported a reduction in boiler capacity requirements from 125 to 80 HP, and a definite increase in the efficiency of steam-heated kettles and other processing equipment as a result of proper trapping. Heating is faster and temperatures are more uniform and nearer theoretical pressure-temperature figures than formerly.

Some savings examples in other plants: Chemical company saves $25.00 per day with 17 Armstrong traps . . . one $29.00 trap saves $250 yearly in ammonia plant . . . coal requirements in insulator plant reduced from 5000 lbs. to 3000 lbs. per day.

In all industries, men who check their steam costs prefer Armstrong inverted-bucket traps

Armstrong traps get amazing results in all industries because of their principle of "complete" trapping. To get maximum return from the investment, it is necessary that the traps not only pass condensate as fast as it forms, without leakage of steam, but also eliminate air from the system and have the ability to handle all ordinary sludge and sediment. Armstrong traps do this through a combination of design features found in no other method of draining condensate. The patented free-floating valve and other engineering components insure freedom from wiredrawing in the valve orifice, permit holding tight against vacuum, and insure long life with negligible maintenance. In terms of hot condensate capacity, Armstrongs are very large in size and low in cost. Considerably over a million in use. Available in straight-through, angle and vertical piping styles, in all sizes and pressures.

Standard Armstrong traps, and special traps for air, water, gasoline and other services, are described and illustrated in the Armstrong Trap Book, which also contains valuable data on operation, installation and service. We'll be glad to send you a copy.



ARMSTRONG MACHINE WORKS

812 MAPLE STREET • THREE RIVERS, MICHIGAN

ARMSTRONG TRADE MARK INVERTED BUCKET STEAM TRAP

Armstrong

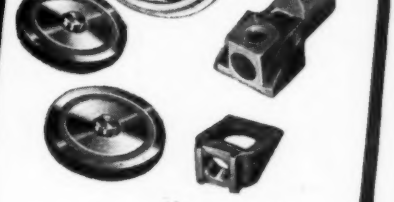
There's a Shortage of DARLING GATE VALVES IN THE JUNK PILE

Today, junk piles are being combed for every valve that can be salvaged. Chances are, you won't find a single Darling Gate Valve—because they just *don't* end up in the junk pile! Darling Gate Valves stay on the job—right in the line—year after year—delivering tighter seating, better performance, less wear, more efficient operation at lower maintenance cost.

When, after long and severe service, the parts should become worn, there is no need to remove the valve from the line. You just replace 4 simple and inexpensive parts and the Darling Double Disc Gate Valve is again ready for long, hard service.

Darling Valves Are Still Available To Industry!

In spite of our heavy war production schedule, we *do have* industrial valves to sell—perhaps the very ones you need for that critical installation in your plant. We suggest that you phone, wire, or write, giving as much information as possible on your valve requirements, priority ratings, and all other data that will help us expedite shipments to you. Requests will be given immediate attention, in the order received at our plant.



Only 4 PARTS

Two discs and two wedges—the entire working part assembly of a Darling Double Disc Gate Valve. There is no other valve with this design. The seats are parallel. The discs are *fully revolving*, seating in a different position each time the valve is operated. This means tighter seating, less wear, longer operation and lower maintenance costs with Darling Gate Valves.

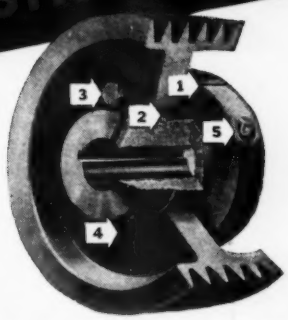
You don't have to take a Darling Double Disc Gate Valve out of the line to replace the parts. Simply insert new and inexpensive assembly parts and replace Stem and Bonnet. Valve is again ready for long, hard service.

TRADE DARLING MARK

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

THE SAME *Simple Construction* IN ALL SIZES

WORTHINGTON QD QUICK DETACHABLE SHEAVES



1 Split hub for easy mounting or removal from shaft.

2 Tapered fit between hub and rim for easy mounting or removal of rim from hub.

3 Pull-up bolts for tighter fit of rim on hub.

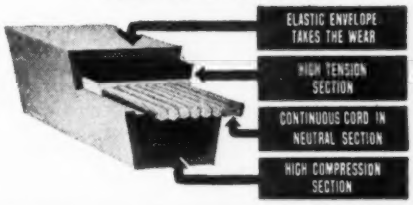
4 Tapped holes in rim in which bolts act as jack screws for easy removal of rim from hub.

5 Cap screw holds hub in position on the shaft when mounting or changing sheave rim.

WORTHINGTON

GOODYEAR EC CORD

MULTI-V-BELTS



ADD the extra advantages of Worthington QD Sheaves to the well-known superiority of Goodyear EC Cord Belts, and it becomes apparent why machine designers, engineers, foremen, and mechanics from coast to coast are enthusiastic about Worthington Multi-V-Drives.

QD ("Quick Detachable") Sheaves — with split hub and tapered fit — can be put on or taken off . . . by a man (or a woman) and a wrench. . . in 60 seconds. Tapered friction drive and positive press fit. Vari-sized rims fit same hub.

Goodyear's contribution to Worthington Multi-V-Drives' superiority is the V-Belt having the unique feature of double-paralleled rows of low-stretch, high-strength cords in the heavier sizes.

For further information, write or call the Worthington Multi-V-Drive dealer or the nearest Worthington district office in your territory.

Use the coupon below — today.

YOUR MONEY'S WORTH

WORTHINGTON

Standard Products Division
Worthington Pump and Machinery Corporation
Harrison, N. J.

Please send me literature describing in detail the advantages of Worthington Multi-V-Drives, with QD Sheaves.

Name..... Title.....

Company..... .....

Address..... . ...

City..... .... State.....

Product Manufactured ....

MV 4-1

WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

The Cost Is What You Make It

★ Air is a peculiar industrial commodity. The poorer its quality, and the less you get—the more it costs.

First, you pay for air with every dollar invested in compressors and their operation and maintenance.

Then you find that dirty air is the most expensive kind, because it raises general hob with your equipment, and sends maintenance costs sky-high.

But clean air can be expensive, too. That happens when air cleaning devices obstruct intake air and reduce compressor output.

The most economical air is clean—to minimize maintenance costs. It is filtered with little restriction—to maintain rated compressor capacities. Air-Maze Oil Bath filters are designed to give you this kind of low-cost air *because their high efficiency and low restriction remain constant* due to automatic oil-washing action.

That's a statement we'll be glad to prove in your own plant.

★

STOP NOISE, TOO!

Intake noise can be effectively reduced with Air-Maze filter silencers. Oil bath type filter, with automatic oil-washing action, is combined with specially designed acoustical chamber. Write for catalog sheet.

AIR-MAZE CORPORATION • *Engineers and Manufacturers* • **CLEVELAND 5, OHIO**

Representatives in Principal Cities • *In Canada:* Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor

AIR-MAZE

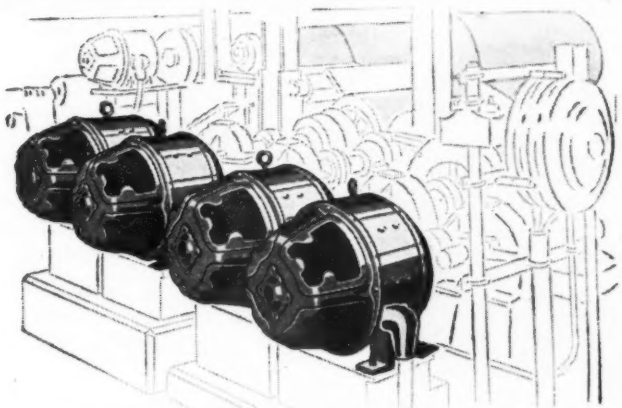
SPECIALISTS IN AIR FILTRATION

VERSATILE!

To anyone accustomed to thinking of motor-drive as primarily a source of power alone, the *versatility* of Reliance Motor-drive is often a source of genuine surprise.

Without clutches, gears or complicated controls, it provides for quick but smooth acceleration—speed variation with very slow speeds for inching—automatic reversing—quick stopping—control of tension—all these readily adaptable to a wide variety of operations in many industries.

The results of Reliance pioneering with many applications of motor-drive are worthy of serious attention in connection with any problem involving machine design or the improvement of production processes. A Reliance engineer will be glad to place the results of this experience at your service any time.



The versatility of Reliance Motor-drive is typified by its application to 4-drum paper winders. Features are: convenient, accurate, safe control. Results are: uniform, snug rolls that please the men who buy and use them.

RELIANCE A·C D·C MOTORS

RELIANCE ELECTRIC & ENGINEERING CO.

1088 Ivanhoe Road • Cleveland, Ohio

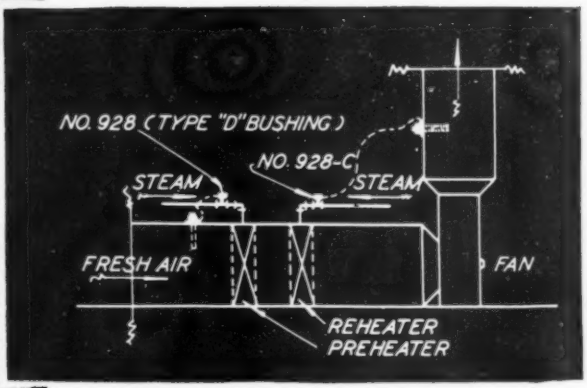
Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit • Greenville (S.C.) • Houston • Los Angeles • Minneapolis • New York Philadelphia • Pittsburgh • Portland (Ore.) • St. Louis • Salt Lake City • San Francisco • Syracuse • Washington, D. C. • other principal cities.

COMFORT... UNDER CONTROL

WHEN air conditioning systems are equipped with Fulton Sylphon Regulators, room temperatures *stay* at an ideal point continuously. These instruments provide *modulating* action . . . not a sharp correction from an overheated or cold condition.

This means economical use of fuel, and increased tenant satisfaction. And, to the building owner, Sylphon Regulators bring many other advantages. They are simple and rugged in construction, usually completely self-powered, and can be depended upon for years of trouble-free service.

There are many different types of Sylphon Regulators, and for most requirements of air conditioning systems. Available *now* for essential commercial installations. Ask for Bulletin CS-821.



Fulton Sylphon Regulators, No. 928 and No. 928-C installed in a central fan ventilating system and providing pre-heated freeze protection and maintaining desired temperature of delivered air.

TEMPERATURE CONTROLS . . .

FULTON SYLPHON

BELLOWS . . . BELLOWS ASSEMBLIES SINCE 1904

THE FULTON SYLPHON CO., KNOXVILLE 4, TENNESSEE

Canadian Representatives, Darling Bros., Montreal, Canada

COTTRELL PROCESS

of

ELECTRICAL PRECIPITATION

universally recognized as a
standard method of removing

DUST, FLY ASH, FUME, MIST & FOG

***from* GASES**

•

30 years of research, development and operating experience throughout the world are incorporated in the

COTTRELL INSTALLATIONS

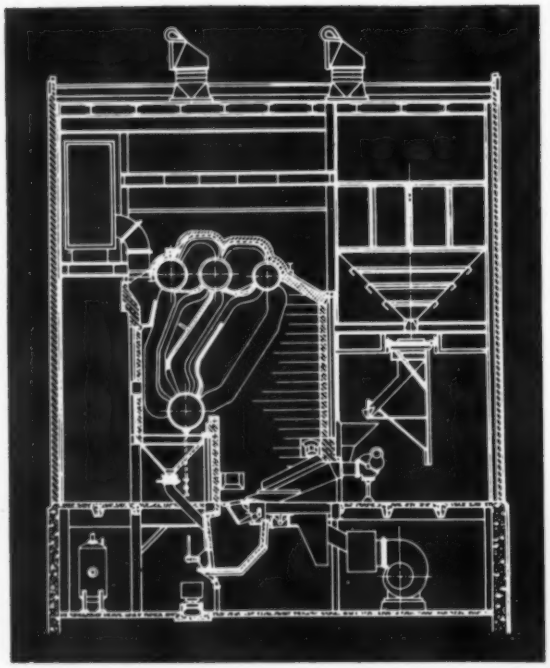
offered to meet the requirements
of any problem by

RESEARCH CORPORATION

405 LEXINGTON AVENUE
NEW YORK CITY

59 EAST VAN BUREN STREET
CHICAGO, ILL.

GET INTO THE FIRING LINE!

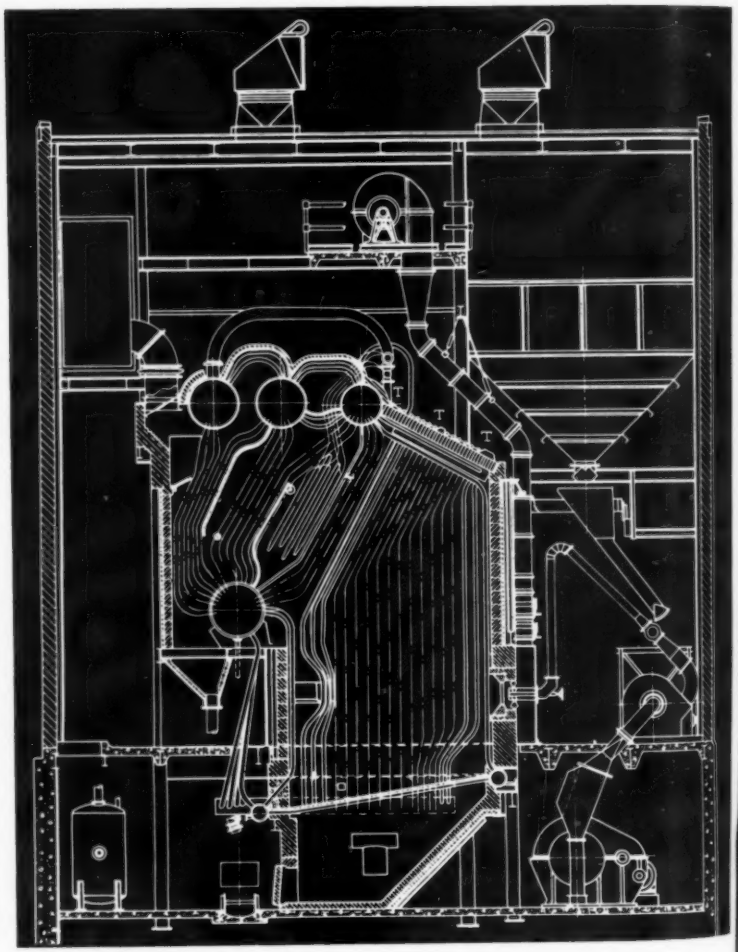


START REHABILITATING YOUR BOILER PLANT NOW

Prepare to burn the lower grade coals economically in your existing boilers by installing Kennedy Air Swept Tube Mills

OHIO MUNICIPAL POWER PLANT CONVERTS EXISTING BOILERS TO PULVERIZED COAL

BURNS DOMESTIC OHIO STRIP MINE COAL SAVES $20,000 PER YEAR IN COAL COSTS



LOOK AT THE RECORD

BEFORE

Ohio Municipal Power Plant: used two boilers to carry average plant load of 35,000 lbs. per hour, 250 lbs. pressure. Burned best Imported West Virginia Coal.

AFTER

INSTALLED KENNEDY AIR SWEPT TUBE MILL AND WATER WALLS. Boiler capacity increased 33% to 47,000 lbs. per hour each. Load carried on one boiler, other boiler kept for standby. Burned Domestic Ohio Strip Mine Coal costing $1.50 less per ton delivered at their plant. Boiler efficiency 80%.

Let us help you with your boiler problem. Write for our Bulletin No. 12; also for our Bulletins on Drying, Grinding and Pulverizing Anthracite Coal.

ARMY E NAVY

KENNEDY-VAN SAUN · QUALITY · SERVICE · Kennedy Products · NEW YORK · USA · MFG. & ENG. CORP.

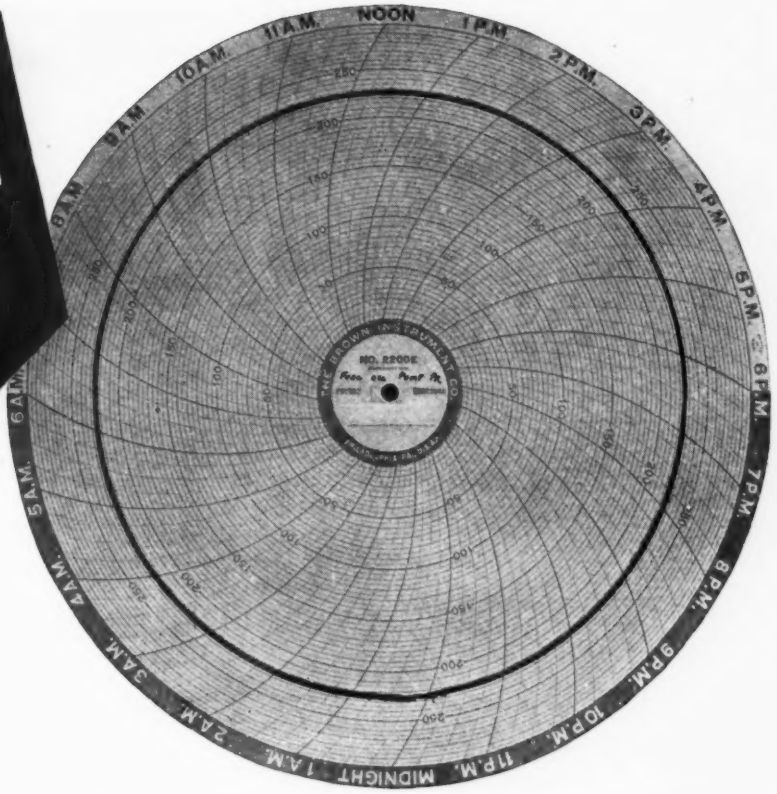
Kennedy-Van Saun

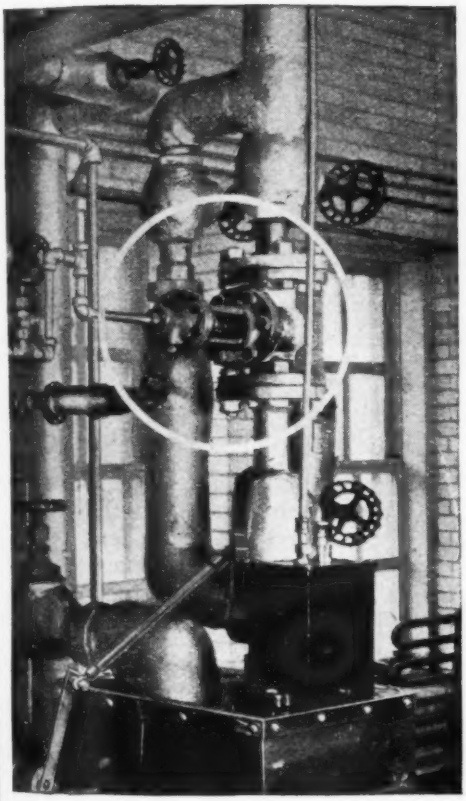
MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVE., NEW YORK 16, N. Y.

FACTORIES:—DANVILLE, PA., CANADA, LONDON, AUSTRALIA

What's WRONG with this Curve?





Foster Type 38-P6 Pump Governor installation showing proper by-pass arrangement—for full details see Catalog 70.

★ BUY WAR BONDS ★

It looks too broad—as though the pen had picked up a piece of fuzz—but that's not *why* it's broad. The answer is, it is actually *SEVEN* curves. Paper is scarce, and each chart, although checked daily, is being used for one week instead of one day.

Still, the curve is *flat*, with *no nicks*, and it shows how closely a nine-year-old Foster 38-P6 Pump Governor is regulating discharge pressure on a duplex fuel oil pump, twenty-four hours a day, seven days a week. Furthermore, charts for other weeks tell an identical story, because this governor is the right size and type for the job, and it was properly installed.

Your problem may be different. If it involves pressure or temperature regulation, however, you can be sure that there's a specific Foster Valve to give you equally satisfactory performance, because there's a Foster Valve for *every* service requirement. And our engineers will be glad to help you get the right valve.

Illustrated catalog on the complete Foster line, with many pages of useful engineering data will be sent if the request is made on company letterhead. Simply ask for Catalog 70.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

106 MONROE STREET • NEWARK 1, N. J.

2-FE-3

Looking ahead with Asbestos

THE MIRACLE MINERAL

and the flight metal

The metal of the moment is magnesium. The miracle mineral that has helped make this industry's amazing growth possible is...Asbestos.

Millions of square feet of K&M "Century" Asbestos Corrugated and Flat Sheet material, for example, have gone into roofs and sidewalls, interior linings, fire resistant partitions, cover plates and insulators in many of the large magnesium plants from Texas to Michigan. The reason why these important producers turned to "Century" is simple—the necessities of war called for a material that could be rapidly installed, while plans for the future made permanence equally important.

The fact that K&M "Century" Corrugated and Flat Sheets are being re-ordered, time and time again, for plant expansion and new construction, is ample proof that their performance is satisfying all requirements.

Naturally, this maintenance-free sheet material has been in great demand for *all* types of essential wartime construction, but now that many of these obligations have been met, it is now available in greater quantity than ever before.

Just as magnesium has helped turn the tide of war in the air and is ready to usher in a new age of flight, so are we at K&M looking ahead with the miracle mineral . . . Asbestos. From today's research will come new and improved products, and a far broader range of service in the "V" years ahead.

* * *

Nature made asbestos;
Keasbey & Mattison, America's asbestos pioneer,
has made it serve mankind . . . since 1873

KEASBEY & MATTISON

COMPANY, AMBLER, PENNSYLVANIA

ARMY E NAVY

K&M best in asbestos

★ Our Ambler plants proudly fly the Army-Navy "E" flag—an honor awarded K&M employees "for outstanding production of war materials."

S—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGIN

BURGESS SNUBBER BULLETIN on Diesel Exhaust Noise Control

THE EFFECT OF PROPER EXHAUST DIMENSIONS

An exhaust pipe of the correct length and diameter, on a two-cycle Diesel engine, will produce higher engine efficiency than an exhaust pipe of other dimensions. Such a pipe will also scavenge the cylinder without help from crankcase air pressure, and it can create a super-charging effect.

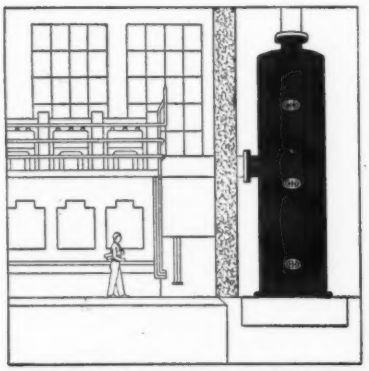
How this is done can be seen in the animated diagram. It shows what happens inside a cylinder of a two-cycle crankcase scavenged Diesel engine with a properly dimensioned exhaust system. The white men represent clean air and the dark men are the burned gases. The piston is starting up on the compression stroke. The transfer port is closed and the exhaust port is still slightly open.

Burned gases, which can be seen as the little dark men in the exhaust pipe, escaped through the exhaust port during the preceding downstroke, while air in the crankcase was being compressed to about five pounds gauge pressure. A negative pressure (partial vacuum) thus produced in the cylinder by the outrush of burned gases caused the air in the crankcase to scavenge the cylinder and part of the exhaust system. With the exhaust pipe of the correct dimensions so that it is properly related to the particular engine, the pull of the vacuum alone is sufficient to fill the cylinder with fresh air from the crankcase without any help, provided the air from the atmosphere can flow into the crankcase freely.

This scavenging action continues until the piston reaches the position shown in the diagram where it closes the transfer port, pinching off the fresh air from the crankcase.

Fresh air flows out the exhaust port until the pressure in the cylinder is below atmospheric. Then due to the pressure differential, some of the fresh air in the exhaust system is "rammed" back into the firing chamber as the rising piston closes the exhaust port.

The important point here is that with a properly adjusted exhaust system, the last of the air pushed back into the cylinder is fresh and clean, and therefore assures good combustion. This reverse flow actually produces a super-charging effect. The volumetric efficiency of the engine rises above the efficiency obtained when the exhaust pipe is of such a length that clean air and exhaust gases race back and forth through the exhaust port while it is still open. Under the latter condition, burned gases may be forced back into the cylinder and cause poor combustion.



PLANNING FOR POST-WAR POWER PLANTS

One of the essentials of good planning for post-war power plants is to provide trouble-free exhaust systems for Diesel engines. While there are several ways to install Burgess Diesel Exhaust Snubbers, the method illustrated here is the simplest. The exhaust pipe from the manifold near the top of the engine is carried straight out to a side inlet Snubber. No supporting brackets are needed with this type of Snubber, since its base is fitted with a flange which can be bolted to the foundation. This Snubber will operate with equal high efficiency whether it is close to or far away from the engine.

One of the outstanding features of the Southeastern Indiana Power Company Plant at Rushville, Indiana, is the Burgess combination exhaust Snubbers and waste heat boilers. The Snubbers prevent the annoying exhaust noises from disturbing nearby residents. The boiler section of the Snubbers acts as a fire tube, hot water boiler to heat the various fuel and lubricating oil tanks, as well as the office and locker room, and provides hot water for showers and lavatories. Another economy feature is the heating of the plant building with hot air drawn from around the metal jackets of the Snubber bodies.

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—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGINA
LETE SATISFACTION IN EXHAUST AND INTAKE QUIETING—SPECIFY BURGESS SNUBBERS—FOR COM

THE SIGN
OF THE DODGE
TRANSMISSIONEER

WHAT IS TRANSMISSIONEERING?

Transmissioneering is a Dodge engineering technique starting with a study of practical production engineering requirements and resulting in "The Right Drive for Every Job." It is the connecting link between power source and production machine.

Transmissioneering involves the component parts of power drives — bearings — pulleys — sheaves, clutches, etc., each transmissioneered to meet definite service conditions and the assembling of these parts to provide effective drive units.

Dodge transmissioneers in industrial centers provide on the job tranmissioneering and a wide selection of Dodge transmissioneered products available from stock. Call your local Dodge transmissioneer — he will show you how to put *all* your power in the job.

DODGE MANUFACTURING CORPORATION
Mishawaka, Indiana, U. S. A.

BUY MORE WAR BONDS

The Sign
of the Dodge
Transmissioneer
"Transmissioneering starts with the study of Practical Production Engineering requirements and stops with the Right Drive for Every Job."

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Dodge Manufacturing Corporation

• • • THE RIGHT DRIVE FOR EVERY JOB

"WHAT WE CAN'T DO WITH PIPE IS NOBODY'S BUSINESS"

If your Piping problems appear as complicated as our artist's conception, pack up your specifications and send them along to "Flori."

Our Engineers have licked some tough ones . . . and that gives us confidence to repeat---"We make anything that can be fabricated of Tubular and Plate Steel."

Specialty fabricated systems for Steam, Air, Water, Oil, Gas, and Chemicals

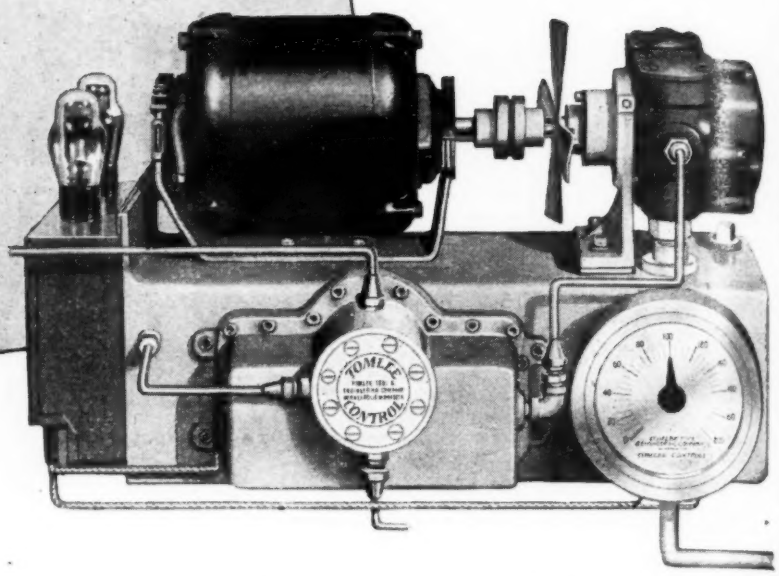
A WAR-BUSY PLANT

NOW SUPPLYING COMPONENT PARTS AND COMPLETE SYSTEMS FOR INVASION BARGES, TANKERS, CARGO VESSELS, AIRCRAFT, TANKS AND ORDNANCE.

FLORI PIPING

THE FLORI PIPE COMPANY, ST. LOUIS — CHICAGO

Use an Electronic Hand to make your REDUCING VALVES More Sensitive



BALANCE of an electronic hand that will make your reducing valves more sensitive to changing impulses is provided by the Tomlee Electronic Control System.

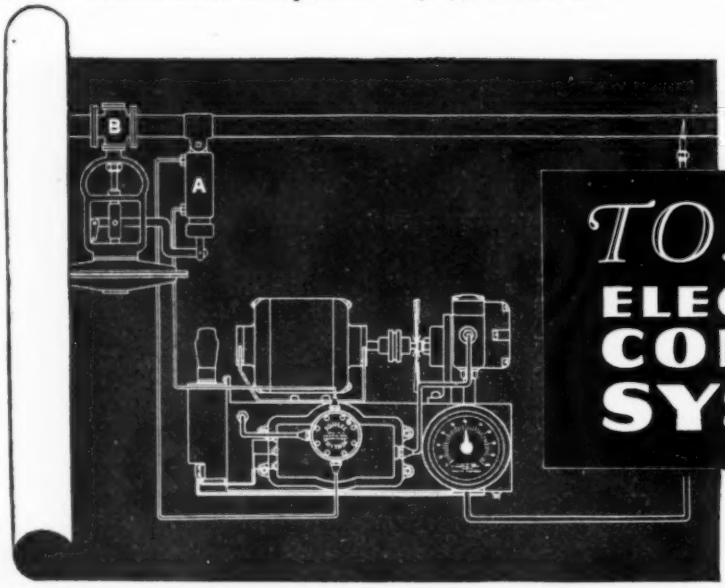
Your reducing valves have been serving you well for many years, but today's demands for closer and closer control call for quicker response . . . instant reaction.

Connected in a line between the impulse tube and the reducing valve, Tomlee Electronic Control System gives you the infinite sensitivity demanded by modern operating cost requirements. This device is so sensitive that it will record and correct minute variations in any pre-set value in milliseconds. By so doing, the Tomlee System eliminates "lag," avoids the accumulation of repeated errors that increase cost. Use of the Tomlee Electronic Control System shows a very material saving in fuel cost.

The schematic drawing below shows how easily the Tomlee Control can be incorporated into your steam system . . . how its combination of electronic, electrical, hydraulic and mechanical operation can modulate the reducing valve in fractions of 1/1000 of an inch.

The Tomlee Electronic Control System is a simple, compact unit . . . weighs but 50 pounds and is 12″ x 15″ x 20″ in dimensions. For more complete information on your specific requirements, address TOMLEE TOOL AND ENGINEERING COMPANY, 253 Third Avenue South, Minneapolis (15), Minnesota.

Licensed under Patents of Hurley Electronic Controls, Inc.



Slight variations of pressure are transmitted to the Tomlee Electronic Control Unit by the impulse tube. These are converted into hydraulic impulses which actuate piston (A) which modulates reducing valve (B) in fractions of one-thousandth of an inch, thus maintaining any predetermined value with the utmost preciseness.

TOMLEE
ELECTRONIC
CONTROL
SYSTEM

Tube cleaning takes a new turn-

-with the new

ELLIOTT

1300 Series

TUBE CLEANERS

"Tube Cleaner Headquarters" has done it again—stepped up the tempo and the power of cleaning equipment with new developments of far reaching significance. These are particularly aimed at facilitating the cleaning of short radius curves and bends of modern boilers.

1 The new ELLIOTT HINGE COUPLING

2 The new ELLIOTT more powerful motor

3 The strong ELLIOTT cutter head universal joint

The new Elliott hinge coupling takes all the stiffness out of the connection of hose and motor. It is notably strong, assembled "for keeps," and slips easily to the angle required by the tube turn. The new Elliott 1300 Series motor is handier, more powerful, and its design includes a lubrication system which insures a new standard of generous lubrication for *all* bearings — front as well as rear. Means longer service, of course — and also less maintenance, and the transmitting of *more* power to the cutter head.

Check on these major developments. Write us.

Y-198

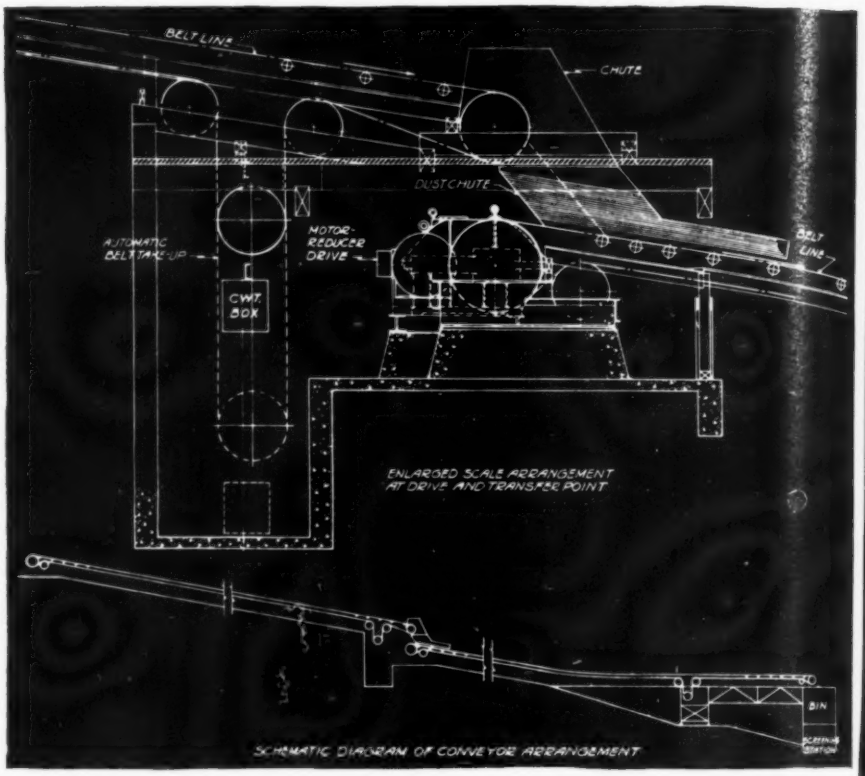
ELLIOTT COMPANY

Tube Cleaner Department
SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

Reversing THE RULES OF NATURE

This Conveyor carries materials down hill in controlled capacities...despite varying densities

. . . and again Robins engineering conquers a difficult problem.



SCHEMATIC DIAGRAM OF CONVEYOR ARRANGEMENT

It seems that Robins is expected to make difficult problems simple. At least, the record of materials handling problems put to us might indicate this to be the fact.

One recent case was typical. A mining company told us that the ores on its property had quite a range of density—variances in the weight per cubic foot ran as high as 30% between the lightest and the heaviest. There was no way of controlling the materials at the source; a run of the lightest ores might change into the heaviest suddenly and without warning.

The company wanted us to design a Belt Conveyor system that would carry these ores down hill at a specified tonnage per hour, regardless of the weight per cf of the material at any one moment. It had to be done without overloading the Belt—and without losing control of the ores due to gravitational pull.

It was done. The Belt Conveyor system is quite elaborate, six of the Conveyors being 1000 feet or more in length. The entire project was designed by Robins engineers, manufactured in the Robins plant. Your Conveyor problem may be simpler—or even more complex. Regardless of its difficulties, regardless of its size, you will get eminently more mental satisfaction and productive efficiency if you turn the matter over to Robins. For Robins originated the method of conveying with a rubber belt, originated the troughing of belts—originated many other materials handling methods and machines in common use today. Isn't it logical that the company with the longest experience should know most about how to do these things best?

Whatever your needs in Belt Conveyors — or other materials handling machinery—get in touch with Robins. A Field Engineer from the nearest of our ten offices will be glad to consult with you—free of cost or obligation. Please address your letter to Dept. P-2.

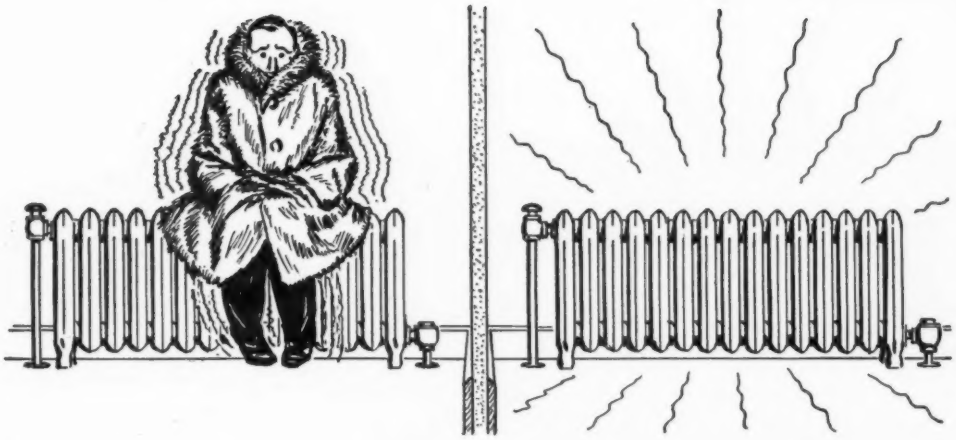
ENGINEERS • MANUFACTURERS • ERECTORS

ROBINS *makes:* BELT CONVEYORS • COAL AND ORE BRIDGES • BUCKET ELEVATORS • CAR AND BARGE HAULS • CAR DUMPERS • CAR RETARDERS • CASTINGS • CHUTES • CONVEYOR IDLERS AND PULLEYS • CRUSHERS • FEEDERS • FOUNDRY SHAKEOUTS • GATES • GEARS • GRAB BUCKETS • PIVOTED BUCKET CONVEYORS • VIBRATING SCREENS • SCREEN CLOTH • SELF-UNLOADING BOAT MECHANISMS • SKIP HOISTS • STORAGE AND RECLAIMING MACHINES AND SYSTEMS • TAKEUPS • LOADING AND UNLOADING TOWERS • TRIPPERS • WEIGH LARRIES • WINCHES • WINDLASSES

ROBINS CONVEYORS
INCORPORATED
Founded in 1896 as Robins Conveying Belt Co.
PASSAIC • NEW JERSEY

FOR MATERIAL AID IN MATERIALS HANDLING . . . . . It's ROBINS

MATERIALS HANDLING MACHINERY



All Radiators Get Adequate Heat

You can't blame distant, cool radiators on fuel rationing when the radiators nearer to your boiler are scorching hot. But you can place the blame on an unbalanced, uncontrolled heating system which is eating up your supply of rationed fuel.

Webster Moderator Systems of Steam Heating with Webster Radiator Orifices assure quick heating-up, full control of steam, and balanced distribution of heat to *every* radiator . . . regardless of its distance from the boiler. Overheating, underheating and costly waste of rationed fuel are ended.

More Heat With Less Fuel

Webster engineers have discovered through surveys of thousands of buildings that seven out of ten large buildings in America (many of them less than ten years old) can get up to 33% more heat from the fuel consumed with the Webster Heating Modernization Program.

Let us show you how to obtain more heat with less fuel this winter. We have a free booklet containing case studies of 268 modern steam heating installations. Write for "Performance Facts" and compare the great savings in fuel obtained with the Webster Moderator System of Steam Heating.

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of Vacuum System of Steam Heating :: Est. 1888
Representatives in principal U. S. Cities :: Darling Bros., Ltd., Montreal

ARMY (E) NAVY
Making Boosters for U.S. Army Ordnance

Webster
Steam Heating

← FROM WEBSTER OUTDOOR THERMOSTAT

Shown at left is the small Control Cabinet of a Webster EH-10 Moderator System, central heat control of the pulsating flow type. It can be used to automatically operate a motorized valve in steam mains, or directly control burner or stoker of your boiler. This moderator System is used chiefly for the small and medium size building. For the larger building, Webster Type E-4 Moderator System is generally recommended. Full details of these Webster Systems on request.

TO STEAM VALVE, BURNER OR STOKER →

This Pipe Line's an Acrobat

These days an army travels on its gas tanks. That's why it's so important for mechanized forces to have portable pipe lines with flexible joints...pipe lines that can do acrobatics.

Ordinarily, you know, pipe lines are buried in the ground and are so rigid that going through rugged terrain requires a lot of real engineering.

But there's no time for that on beachheads and at the front. Pipe lines have to be laid fast...and they can't fail, even if they're strung across rivers, ravines, or deep gullies. They must yield to the force of concussion, yet never leak.

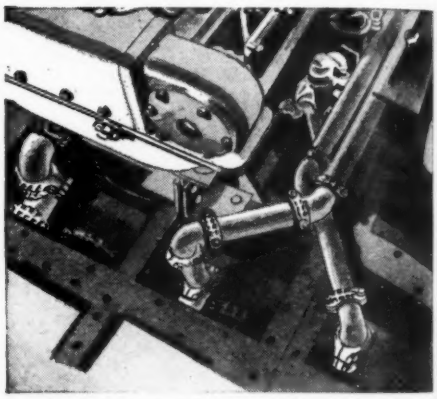
Right there is where Victaulic Couplings* equipped with synthetic rubber gaskets come in. They're easily applied. They permit a high degree of leeway in the laying of the pipe lines.

In the invasion of Africa, for example, pipe lines with Victaulic Couplings made it possible for our mechanized forces to be sure of an adequate supply of oil and gasoline while advancing fast and far across rough ground.

As our armies progress, these rubber elbows in the steel arms that carry essential fuel will play an increasingly important part.

**Product of Victaulic Company of America, 30 Rockefeller Plaza, New York*

VICTAULIC COUPLINGS* are at work in many coal and metal mines far below the earth's surface and on hundreds of ships on the high seas. The flexible gaskets molded by United States Rubber Company resist a wide range of temperature changes, and can be used with safety on, above, or below the ground.



THE VICTAULIC GASKETS, of synthetic rubber, are impervious to the destructive action of high octane fuels. Victaulic Couplings can thus be used for pipe lines that convey oil, water, air, sludge!

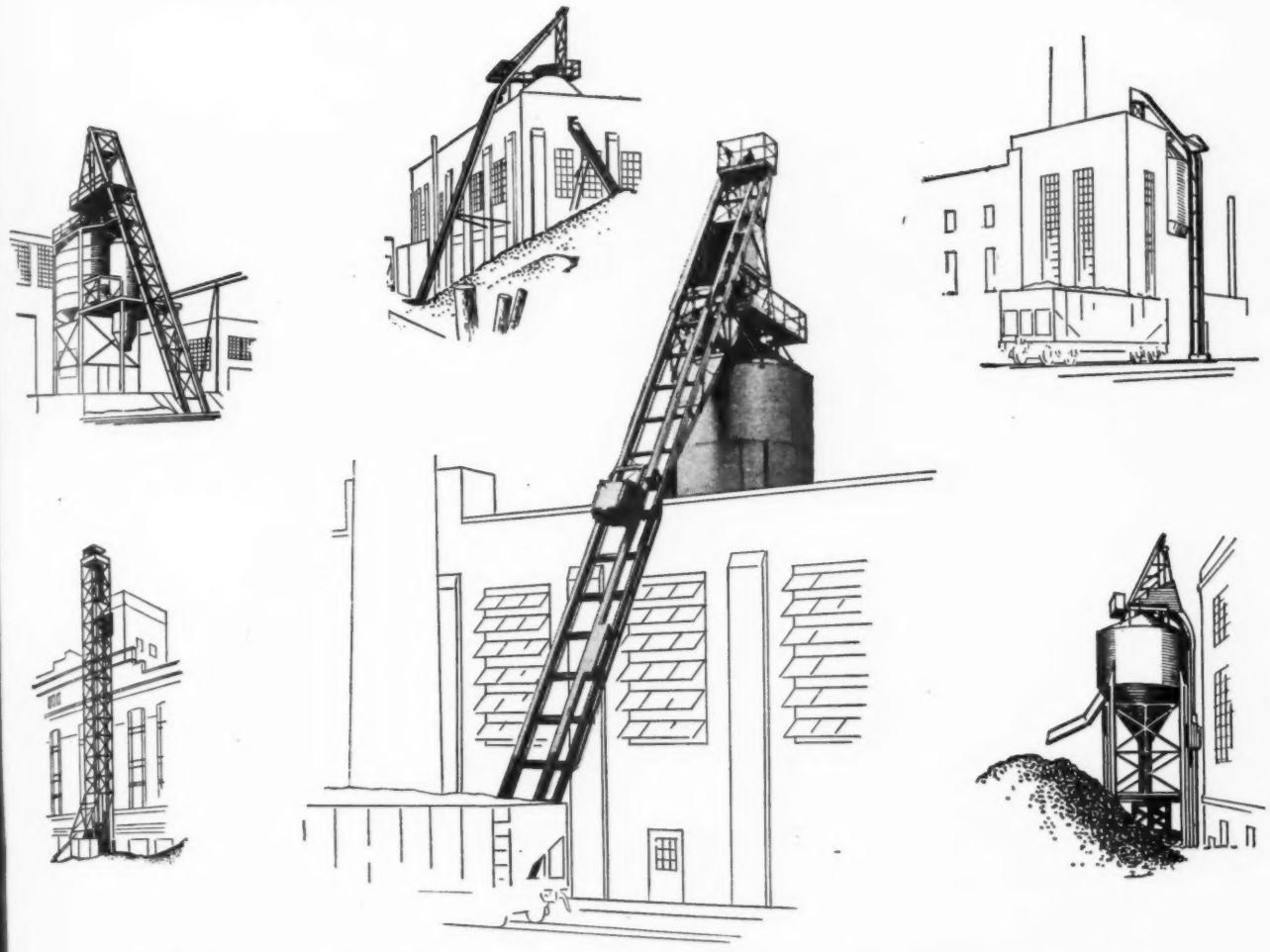
THE FLEXIBLE SEAL of the flexible joint. Victaulic Couplings provide flexibility in pipe lines made of long lengths of rigid metal pipe. The flexible seal is formed by these gaskets, molded from synthetic rubber.

• • •

Listen to the Philharmonic Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E. W. T. Carl Van Doren and a guest star present an interlude of historical significance.

1230 Sixth Avenue • Rockefeller Center
New York 20, N. Y.

UNITED STATES RUBBER COMPANY



They tick away the years to the *Rhythmic Flight* of their buckets

● Skip Hoists—*(conceived and developed by Bartlett-Snow Engineers, whose first installation, made in 1907, is still in active daily service)* —are ideally used when the lift is high and the material abrasive. Those of Bartlett-Snow design featuring the many improvements built into our equipment during this 36-year period, are coming into constantly wider use for handling coal in central stations and industrial boiler plants.

Bartlett-Snow Skip Hoists will raise coal from the track hopper to an overhead bunker for delivery to a weigh larry, larry car, belt conveyor, flight conveyor or other distributing system with unsurpassed dependability and at low cost. They avoid banging—and spilling—at either the loading or discharge points—operate without manual supervision until the track hopper is empty or the overhead bunker filled —and—with only reasonable inspection and lubrication, will give not years, but decades, of faithful, dependable, reliable service.

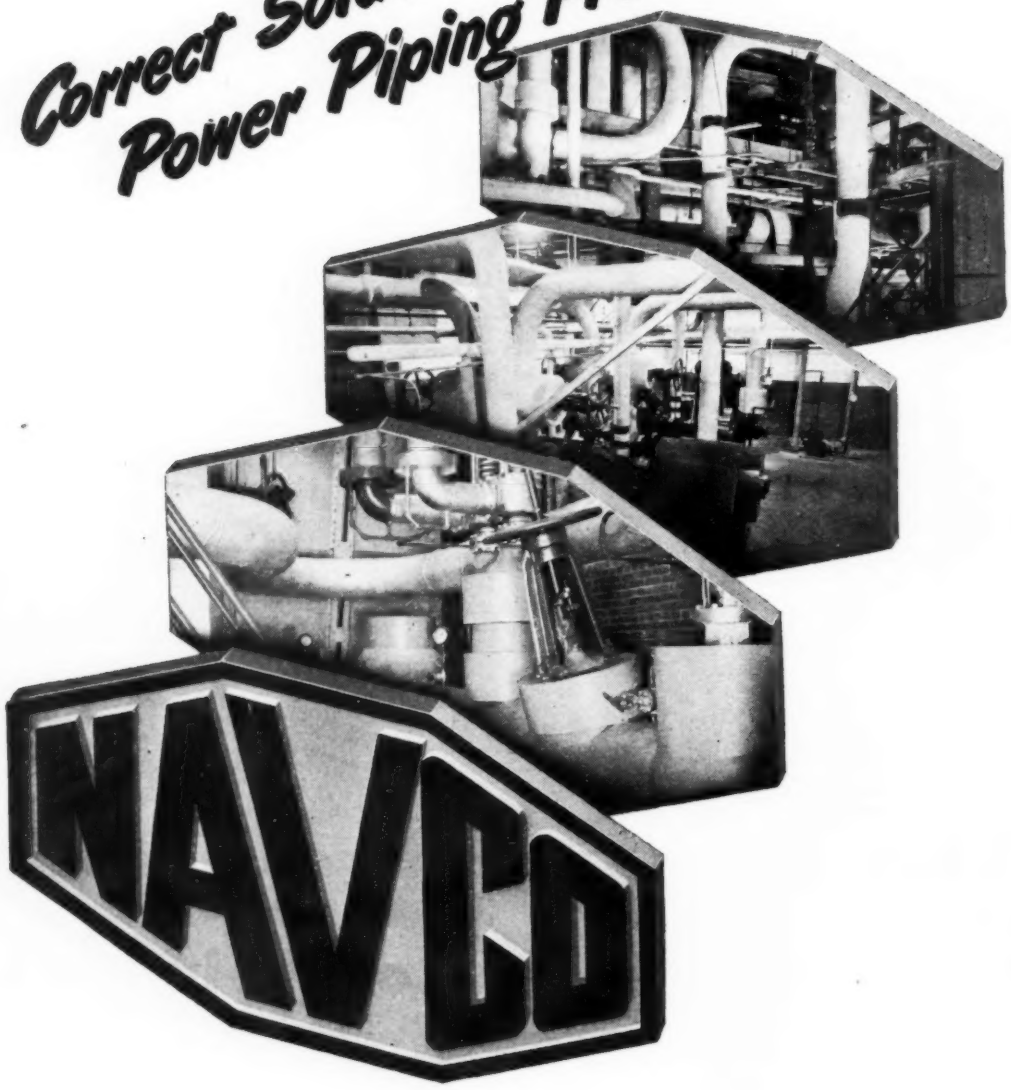
Our Bulletin No. 83, which describes in detail the use of Skip Hoists in handling coal, and contains much other information of interest to every works manager, engineer, and power plant superintendent, will be sent gladly on request to—Coal Handling Department—The C. O. Bartlett & Snow Co., 6205 Harvard Ave., Cleveland, O. Why not send for a copy today?

BARTLETT-SNOW COAL HANDLING

CENTRAL STATIONS and INDUSTRIAL BOILER PLANTS

TRACK HOPPERS • SKIP HOISTS • BUCKET ELEVATORS • BELT CONVEYORS
BINS AND BUNKERS • WEIGH LARRIES • FIELD STORAGE • ASH HANDLING

Correct Solution to Power Piping Problems

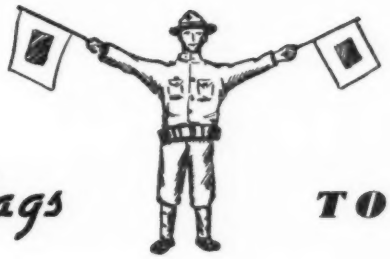


Whatever your piping problem may be, Navco is in position to help you. The knowledge which we have gained in the past thirty-five years has not been confined to design and fabrication alone. It includes a wide field of experience in erecting and testing Piping Systems for every service.

NATIONAL VALVE & MANUFACTURING CO.
PITTSBURGH, PA.

NAVCO

NAVCO PIPING



From Signal Flags **TO HANDY-TALKIE**

THERE HAS BEEN MUCH PROGRESS, TOO,

IN *Water Conditioning*

In the Spanish-American War, it was wig-wag. Today, they use two way conversations with headquarters miles away, with a handy-talkie about the size of a two pound box of candy.

★

There has been progress, too, in water conditioning…Those enemies of steam production and other uses of industrial water—scale, corrosion, carryover and embrittlement—can be stopped before they get in their destructive power.

Bird-Archer offers a balanced organization of Mechanical Engineers, Chemical Engineers and Chemists skilled in preventive measures against the destructive effect of bad water. None is better qualified to serve you.

★

SURVEYS · PLANT STUDIES · CONSULTATIONS
TREATMENTS · PLANT DESIGN
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THE BIRD-ARCHER CO.

Water Conditioning Service

NEW YORK 17, N. Y. • CHICAGO 11, ILL. • PHILADELPHIA 40, PA. • MONTREAL, CANADA

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2-BA-1

The Best Laid Plans

INVEST
IN VICTORY
•
BUY WAR BONDS

Include FIRE PROTECTION by CARDOX

War has taught many lessons. One, for example, that merits high rating on any planning program is this: ENGINEERED VICTORY over production can be lost without an engineering victory over fire!

Whether your planning is concerned with war production, conversion, or utilization of new processes, an individually engineered Cardox Fire Extinguishing System offers many distinct advantages for protecting critical fire hazards.

CARDOX PROTECTION COVERS A WIDE VARIETY OF INDOOR AND OUTDOOR HAZARDS

Installed to protect one or many manufacturing operations, a Cardox System can provide means of detecting fires in such places as areas where flammable liquids are processed, used or handled . . . around electrical equipment or at any of a wide variety of key hazards where one fire could stop all production.

HOW CARDOX SYSTEMS PERFORM

Fire in any of these hazards is detected visually or automatically.

An alarm sounds, giving personal notice to leave the fire zone. Time is allowed for complete evacuation of personnel.

A timed mass discharge of non-damaging, non-contaminating cold Cardox CO_2, released into the fire zone, reduces oxygen content of the atmosphere below combustion requirements and cools out the entire fire. Cardox CO_2—in pounds or tons, as required—is discharged into the fire so rapidly that burning time is usually cut to a very few seconds.

Extinguishment of this kind is possible with a Cardox System through engineered application of carbon dioxide maintained at a standard storage temperature of 0°F. The advantage of uniform extinguishing performance can thus be provided indoors or out . . . for large or small fires . . . for one or a number of hazards.

If you would like more information for use in solving current war plant fire protection problems—or for consideration in connection with post-war planning—write for Bulletin 924.

CARDOX CORPORATION • Bell Building • Chicago 1, Illinois

New York • Washington • Detroit • Cleveland • Atlanta • Pittsburgh
San Francisco • Los Angeles • Seattle

MASS DISCHARGE OF CO_2 · ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE CO_2 RESERVE · ENGINEERED SYSTEMS · MANUAL OR AUTOMATIC CONTROL

CARDOX

NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

COMPLETE REPRINTS of this message for poster use will be supplied on request, subject to the limits of our paper allotment.

"The people of the United States have studied the case of Pfc. Clark Brent, who is at the front in Europe. They decided that the allotment being given his wife, Grace Brent, his son, Bobby Brent, and daughter, Susan Brent, shall be reduced one-fourth, effective immediately . . ."

Oh, so you're all excited? Unfair to reduce fighting men's pay, you say? *You are doing it.*

Not by giving them fewer dollars, of course. You wouldn't do that. Oh, no . . .

But Grace Brent and thousands like her are finding that her allotment—those few precious dollars—buys *less* every month. What's the difference *how* you cut those dollars?

You are outbidding Grace Brent. Go ahead and pay more than ceiling prices for your groceries. You'll get them. *She won't.*

There's only so much warm underwear in this country that will fit Bobby and Susan Brent. Do you need it? You can outbid her for it. *It's yours.*

Spend all you can. Point out the mistakes our Government price-control agencies have made. Get yourself a string of black markets. Kick about taxes. Keep doing these things, and eventually you can so reduce the value of Grace Brent's allotment that she can't get by at all. And we hope you meet Pfc. Clark Brent face to face when he returns.

* * *

IF YOU EXPECT TO LOOK A SOLDIER IN THE EYE

Do these three things:

Encourage our representatives in Washington to tax our extra income away. Hard, yes, but not as hard as inflation, and saddling our children with War's cost.

Follow the price control rules. Sure the government agencies have made mistakes. But they're the best we've got and they can do the job if we support them.

Save—invest in War Bonds for America's post-war future and your own. The suckers are the ones who are spending—not the ones who are saving. Think that through.

* * *

Do as good a job on these three things as Clark Brent is doing at the front, and you can face him proudly when he returns. Rogers Diesel and Aircraft Corporation, 1120 Leggett Avenue, New York 59, New York. Builders of diesel-electric equipment and aircraft parts for our armed forces. *Divisions: Hill Diesel Engine Company; Edwards Company; Edwards Aircraft Products, Inc.; Ideal Power Lawn Mower Company.*

TRADE MARK REG.

ROGERS DIESEL AND AIRCRAFT CORPORATION

Diesel Engines, 5 to 2000 h.p. » Gasoline Engines » Generator Sets » Generators » Power Units » Switchboards
Pumping Units » Hydraulic Aircraft Equipment » Recoil Mechanisms » Power Mowers » Power Brushes
Snow Removal Equipment » Streamlined deluxe Railway Motor Trains » Diesel Locomotives

ALCO

PIPING DRAWING LAYOUT TEMPLATE

A Sturdy 4½" x 9½" Transparent Template Complete with 31 Cut Out Symbols, ½", 1", 1½" and 2" Radius Corners Graduated in Degrees, and the Straight Sides Graduated in Inches.

PRICE $1.00

EACH POSTPAID

Due to War Time Restrictions Our Stock of Templates is Necessarily Limited in Number.

AMERICAN LOCOMOTIVE COMPANY:
ENCLOSED FIND $_____ FOR WHICH
PLEASE SEND ME_____ TEMPLATES.
NAME_____
COMPANY_____
STREET_____
CITY_____ STATE_____

A USEFUL NEW DEVICE FOR PIPING DESIGNERS

As one of the leading fabricators of Carbon Steel and Alloy Prefabricated Piping, we use this Template daily to appreciably shorten the preparation time of piping details.

You, too, will find the Template valuable, particularly for the preparation of piping assembly drawings from which quotations and detail drawings can be prepared.

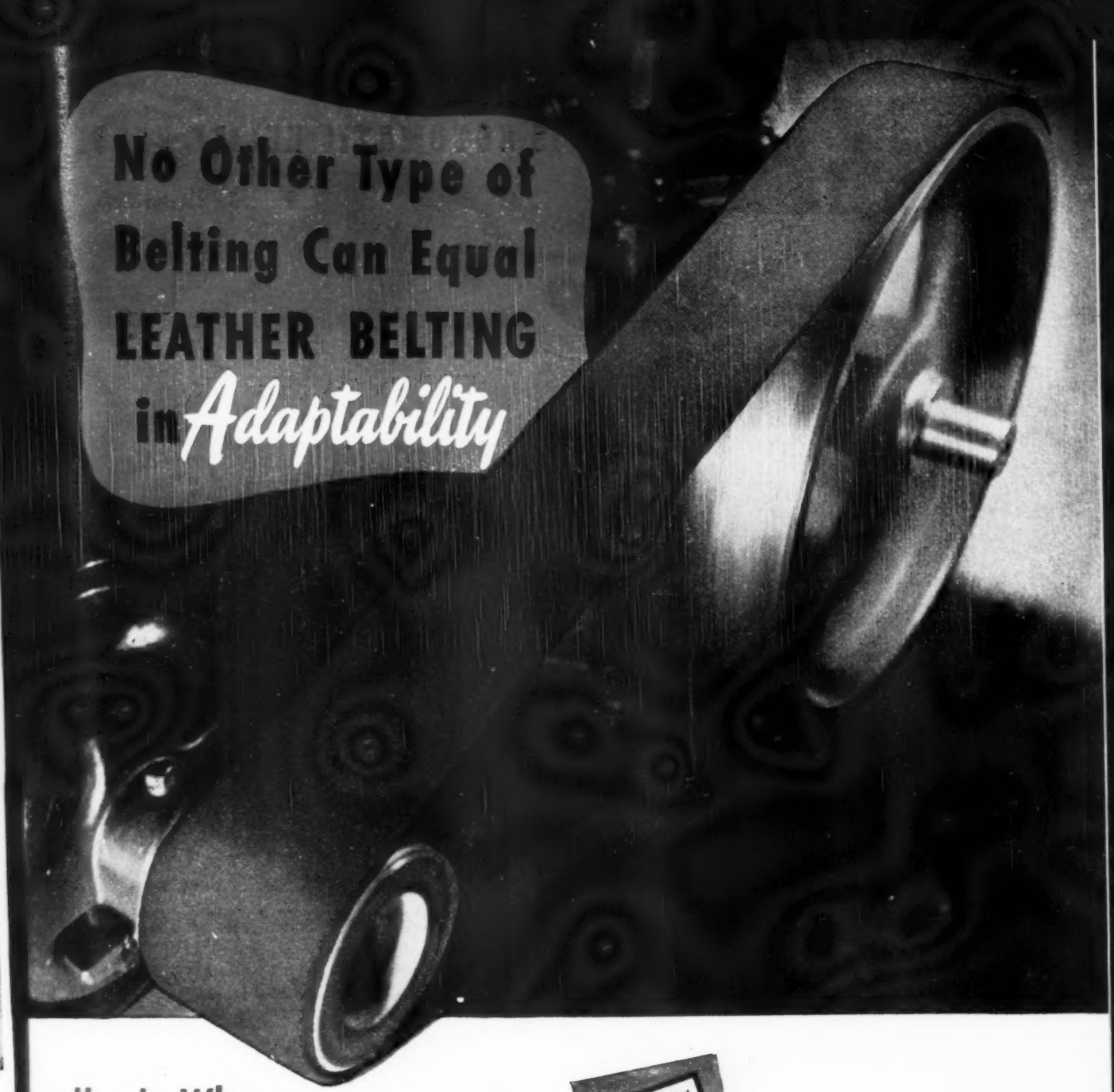
Alco

AMERICAN LOCOMOTIVE COMPANY

ALCO PRODUCTS DIVISION

30 CHURCH STREET • NEW YORK 8, N. Y.

No Other Type of Belting Can Equal LEATHER BELTING in *Adaptability*



...Here's Why: In the average plant, a few widths and thicknesses of Leather Belting will meet practically *all* drive requirements. There is no need to carry in stock a large assortment of sizes. Leather Belting can be cut to any desired length and made endless right *on the job!* It can be spliced on the job easily and perfectly . . . with splices that will not separate in service, will not wear down pulleys.

Leather Belting is more adaptable to varying drive conditions than other types of belting. It will also transmit power effectively over a wider range of speeds and tensions.

Your Leather Belting supplier will be glad to aid you in the proper selection, installation and maintenance of Leather Belt Drives.

Here's How to Get Maximum Service From A Few Sizes of LEATHER BELTING

The authoritative booklet, "How To Get The Most From Your Leather Belting," contains a lot of factual information that will help you to make a few sizes meet your needs.

There are

Horsepower Rating Tables ..... Page 8
Thickness Specifications ..... Page 7
Suggestions on Ordering ..... Page 6
Instructions for Splicing ..... Pages 11-13

and many other valuable suggestions. A copy may be obtained from your Leather Belting supplier or directly from us, without cost or obligation.

AMERICAN LEATHER BELTING ASSOCIATION • 53 Park Row, NEW YORK 7, N. Y.

HERCULES
Seamless Copper
FLOATS

GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

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ADAMANT
FIRE BRICK CEMENT

Provides the EXTRA Strength for Longer Lasting Linings!

. . . in furnaces by making the joints as strong as the brick they bond. This is possible because of the high bonding strength of Adamant, proved by tests as shown below. Use it and keep furnace lining maintenance costs to a minimum. Adamant is ready mixed . . . easy to use.

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Stronger by Test

Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature; 1270 lbs. at 2600° F. Adamant has a P. C. E. of 3000° F. plus. For more details, write . . .

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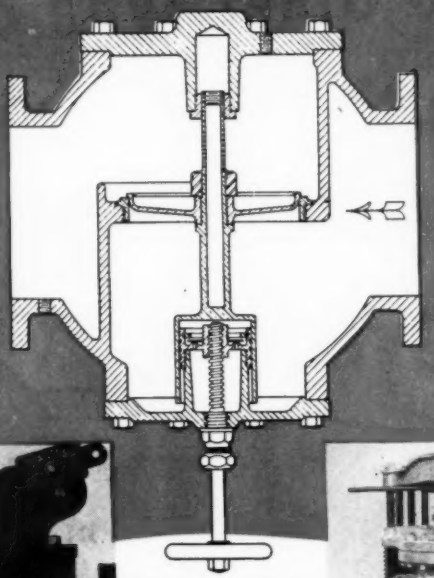
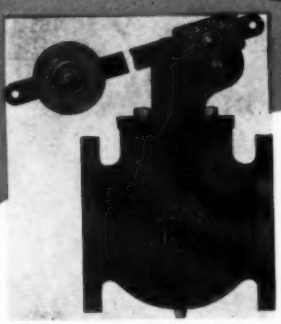
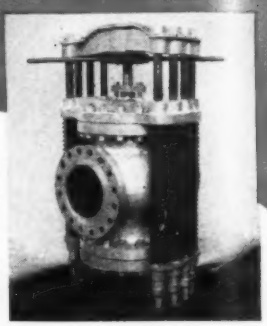
DAVIS AUTOMATIC RELIEF VALVES



Left — No. 110 Exhaust Relief Valve for condenser protection service.



Left—No. 80 "Noiseless" semi-balanced Back Pressure Valve for exhaust lines.



Right—No. 265 Turbine Bleeder and High Pressure Relief Valve.

No power plant valve is more important

In 69 years of specialization on power plant automatic valve specialties, Davis has brought the atmospheric exhaust relief valve to a high point of perfection, with a combination of engineering features not found elsewhere.

Let's look inside the No. 110: The bronze-to-bronze-contact valve is water-sealed through inlet and overflow pipe connections in the body. Valve action is cushioned by a closed-top internal dash pot eliminating sticking of valve due to foreign matter. Flapper valve permits quick opening, slow closing movement. There is full pipe area through the port and all body passages. The valve holds tight under high vacuum, and relieves to atmosphere at a fraction of a pound pressure when vacuum is lost.

Hand lifts, top or bottom, or hydraulic cylinders permit testing the action and holding valve open when desired.

Angle designs available as well as horizontal and vertical, also valves that will function as a relief valve part of the time and back pressure valve at other times, or with hold-open attachment so that valve must be closed manually once it has relieved.

Let us help you on automatic valve problems for steam . . . air . . . gas . . . water . . . and oil.

Ask for ENGINEERING BULLETIN NO. 101A

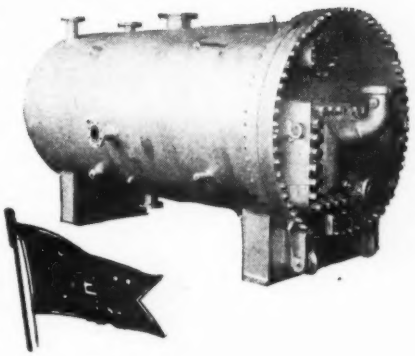
DAVIS REGULATOR COMPANY
2540 S. Washtenaw Ave. Chicago, Ill.

DAVIS AUTOMATIC VALVE SPECIALTIES

G-R *Bentube* EVAPORATOR

SIMPLE CONVENIENT EFFECTIVE

The location of connections is one instance of the convenience and simplicity of the G-R Type R Bentube Evaporator . . . note that steam head, steam connection, and drain connections are all external to the shell.



Other instances . . . no bolted joints or piping within the shell . . . forward tube sheet serves as removable shell cover . . . withdrawal of tube sheet with tube bundle gives full end access to shell interior . . . wheels under cover assist withdrawal of tube bundle.

G-R Bentube Evaporator effectiveness . . . wherever pure water is required from any source of raw or water supply . . . has been proven in more than 3000 stationary and marine installations.

GRISCOM RUSSELL CO., 285 MADISON AVE., NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Practical test* proves EAGLE Super "66" Insulation is non-corrosive—in fact, it is actually rust-inhibitive

Springy Ball Structure

Eagle High Temperature Mineral Wool is nodulated into pellets, or "springy balls," each of which contains thousands of tiny dead air cells which impart high thermal resistance. Pellets keep their dead air cell structure after application. Eagle Super "66" Plastic Insulation forms an efficient monolithic coating without cracks or joints . . . is designed to serve up to 1800° F. . . . is reclaimable and reusable when not subjected to temperatures exceeding 1200° F.

With Super "66" we recommend Eagle INSULSEAL, a fire-resistant, protective coating that safeguards insulation from damage.

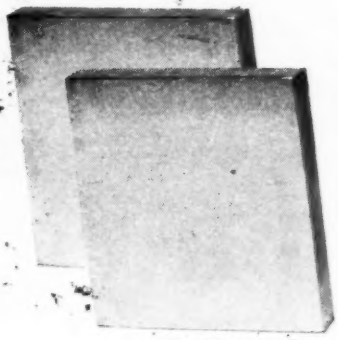
FREE *Manual!*

Shows how insulation on a single Boiler Shell can save you as much as $1,500 a year in fuel costs.

Write for your copy of this timely booklet on how *you* can conserve industrial heat and power with mineral wool insulation.

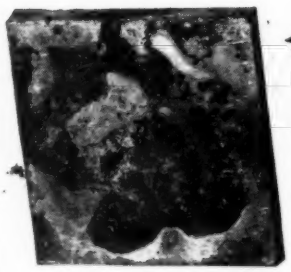
* **AS THEY WERE**

Here's a photograph of two steel blocks before being used to test the anti-rust properties of Eagle Super "66" in the Eagle-Picher laboratory. Note unblemished surfaces. Then study accompanying photos.



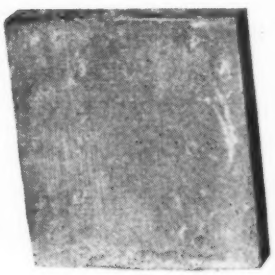
AS ONE BECAME

How one of the steel blocks looked after being imbedded in a regular insulating cement for the test period. Note the extent of the rust. Such corrosion also occurs on iron and steel equipment whether heated or cold.



AS ONE REMAINED

Imbedded in Eagle Super "66" for the same test period, this block shows how effectively the rust-inhibitive and non-corrosive properties of Eagle Super "66" protect your heated equipment.



The above test will readily suggest to you the *protection* Eagle Super "66" Plastic Insulation can give your costly and perhaps irreplaceable heated equipment—quite apart from the sweeping savings on fuel which it affords!

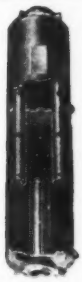
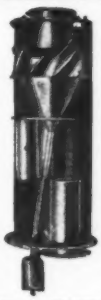
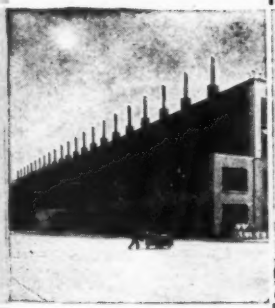
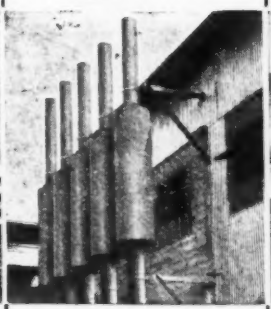
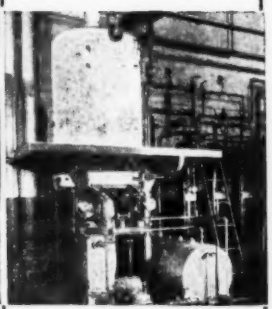
EAGLE-PICHER HIGH TEMPERATURE INSULATIONS

Eagle Super "66" Plastic Insulation
Eagle Supertemp Blocks
Eagle L-T Felts
Eagle Blankets

EAGLE EP PICHER

Eagle Finishing Cements
Eagle Loose Wool
Eagle Insulseal
Eagle Insul-stic

THE EAGLE-PICHER LEAD COMPANY, Cincinnati, Ohio

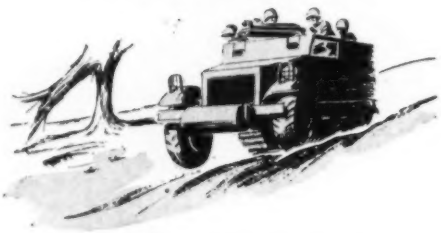
PRODUCT	EXHAUST AND INTAKE SILENCERS	SPARK ARRESTOR SILENCERS	STEAM BLOW-OFF SILENCERS	HEAT RECOVERY SILENCERS
				
USE				
DESCRIPTION	These Maxim Silencers are designed to silence the exhaust or intake of internal combustion engines, steam engine exhausts, air compressor intakes, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Wide choice of models to fit varying space and silencing requirements.	Maxim Spark Arrestor Silencers effectively silence exhaust noise and in addition provide for 100% trapping of all sparks and embers which might come from the exhaust. Of obvious value in marine use, these Spark Arrestors are also applicable to industrial use where a fire hazard exists.	These silencers were developed for use on installations involving the discharge of high velocity steam, air or gas to atmosphere. Used for steam blow-off, safety valve discharges, etc. Silencers shown above installed on high velocity steam exhaust have a total capacity of 135,000 lbs. per hour.	Maxim Heat Recovery Silencers combine efficient silencing of engine exhaust with spark arresting (where necessary) and with the recovery of waste exhaust heat to produce steam or hot water. Highly efficient heat transfer . . . automatic controls . . . may be run wet or dry.
LITERATURE	BULLETINS: D125, D127, D101, D37, D16.	BULLETINS: D105 and D33.	BULLETIN: D111.	BULLETINS: WH100, WH101 and WH103.

THE MAXIM SILENCER CO. • 92 Homestead Ave., Hartford, Conn.

MAXIM

On the Job for Victory

YESTERDAY



AND TODAY

Masoneilan controls and regulators have served industry faithfully since 1882. And are now serving war industries in America and the United Nations . . . well.

Having seen history repeat itself many times, Mason-Neilan was again ready, when this war started, to supply industries with automatic controls and regulators . . . each with the built-in quality characteristics that assure dependable, accurate performance and long life.

Thousands of Masoneilan controls and regulators are in use on land and sea helping to speed victory. Many more are on their way.

A portion of our production of the items illustrated is now available for other than war industries for maintenance and replacement. Catalog 71 is available. Write for a copy.

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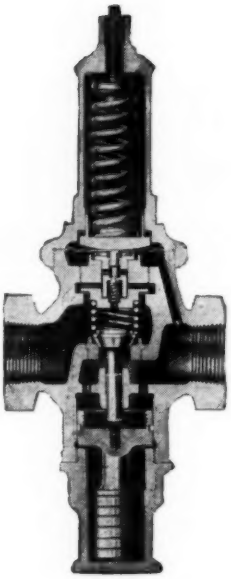
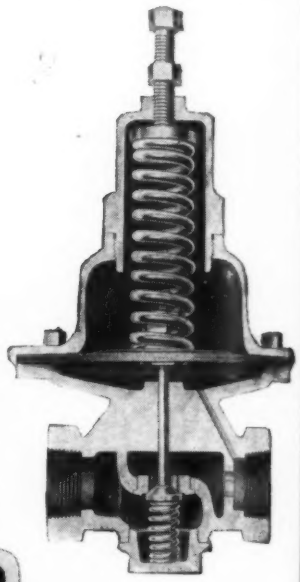
Houston Mason Regulator Co., of Canada, Ltd., Montreal

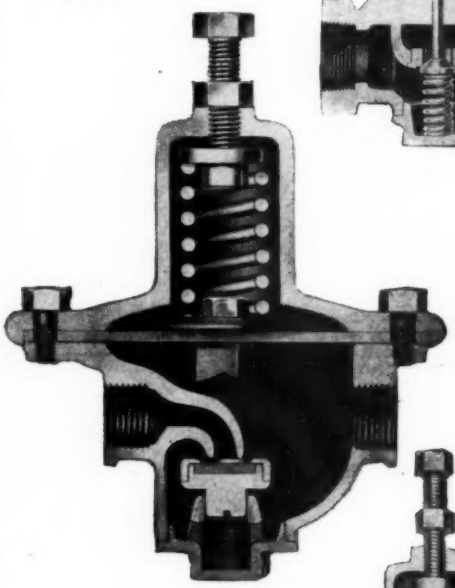


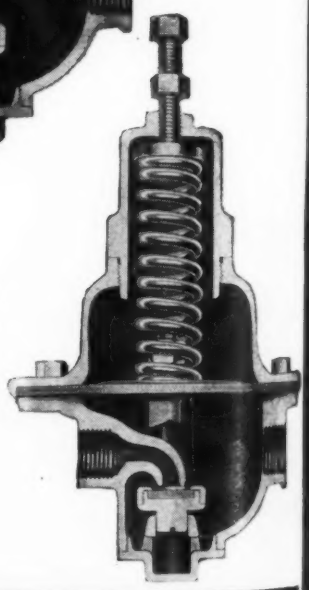
No. 11
For reducing steam pressures. Pilot operated. Sizes — bronze up to 2". Reduced pressure ranges between 5 and 225 lbs.

No. 33
For small steam or air lines, unit heaters or single radiators. Sizes up to ¾". Reduced pressure ranges between 2 and 100 lbs.



No. 227
For domestic or industrial water systems. Requires no attention for years. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.





No. 414
For reducing air pressure in industrial service. Also recommended for dead end service. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.

Welding Fittings of Stainless Steel

A decade spent in the fabrication of all kinds of stainless piping has led to the development of a line of Stainless Steel Welding Fittings by the Alloy Steel Division of Pittsburgh Piping and Equipment Company.

Tees, 45° and 90° Welding Elbows, Reducers, Caps, and Van Stone Welding Necks of Stainless Type Nos. 304, 316, 347, and other alloys are made in sizes ranging from 1" to 24" inclusive. Welded Stainless Steel Tubing is manufactured in sizes ranging from 4" and up, and in the alloys designated above, with wall thicknesses ranging from No. 12 gauge to ½".

The advantages of controlled shop prefabrication, which includes complete facilities for bending, welding, heat treating, machining, and testing, assures the quality and dimensional accuracy of your every stainless piping requirement.

For further information, contact our nearest representative or write us direct.

Pittsburgh Piping AND EQUIPMENT COMPANY

Back The Attack—With War Bonds

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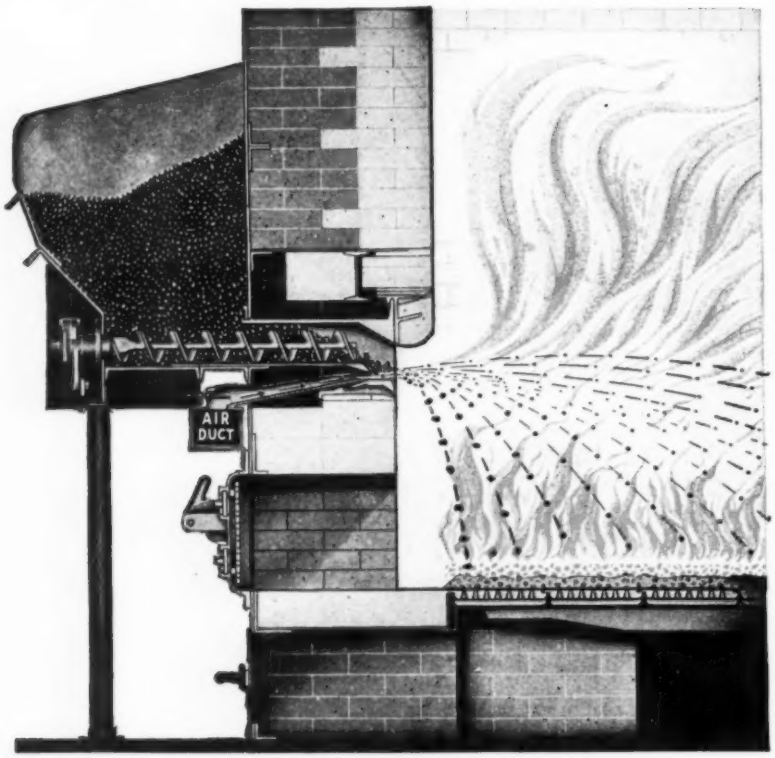
FYR-FEEDER

Multiple SPREADER Stokers



Burn Coal Like Oil!

Whether you need to convert to coal to solve fuel problems, or need greater steam capacity, FYR-FEEDER stokers give you the short-cut answer to both, with additional and important advantages.

Higher Steam Capacity with present equipment may do away with the need for an additional boiler. Many FYR-FEEDER stoker owners have done this. One outstanding example is that of a plant that raised peak rating on a 400 H.P. boiler from 175% to 325%.

Fuel Savings. Another FYR-FEEDER economy is the ability to burn coal that is available locally—any kind of bituminous coal screenings or coal yard sweepings—any type from free-burning to coking coal.

Better Combustion. FYR-FEEDER burns fines in suspension, larger pieces on the grates. Thin fuel bed; coal is spread over the grate, with greater active coal burning area. No dead plates; no clinkers. Fires cleaned in two minutes.

Quick Delivery. Priorities are being granted to plants requiring conversion or more steam capacity, and we can make quick delivery. Installed in large or small boilers with minimum loss of production time and without major alteration to present equipment.

Get in touch with us for an engineer to survey your plant for recommendations on a FYR-FEEDER installation. Full assistance in conforming to priority regulations.

WRITE FOR CATALOG showing results obtained with FYR-FEEDER.

AMERICAN COAL BURNER COMPANY
ENGINEERS • ESTABLISHED 1918
Builders of thousands of Industrial Stokers

32-18 East Erie Street • Chicago 11, Illinois

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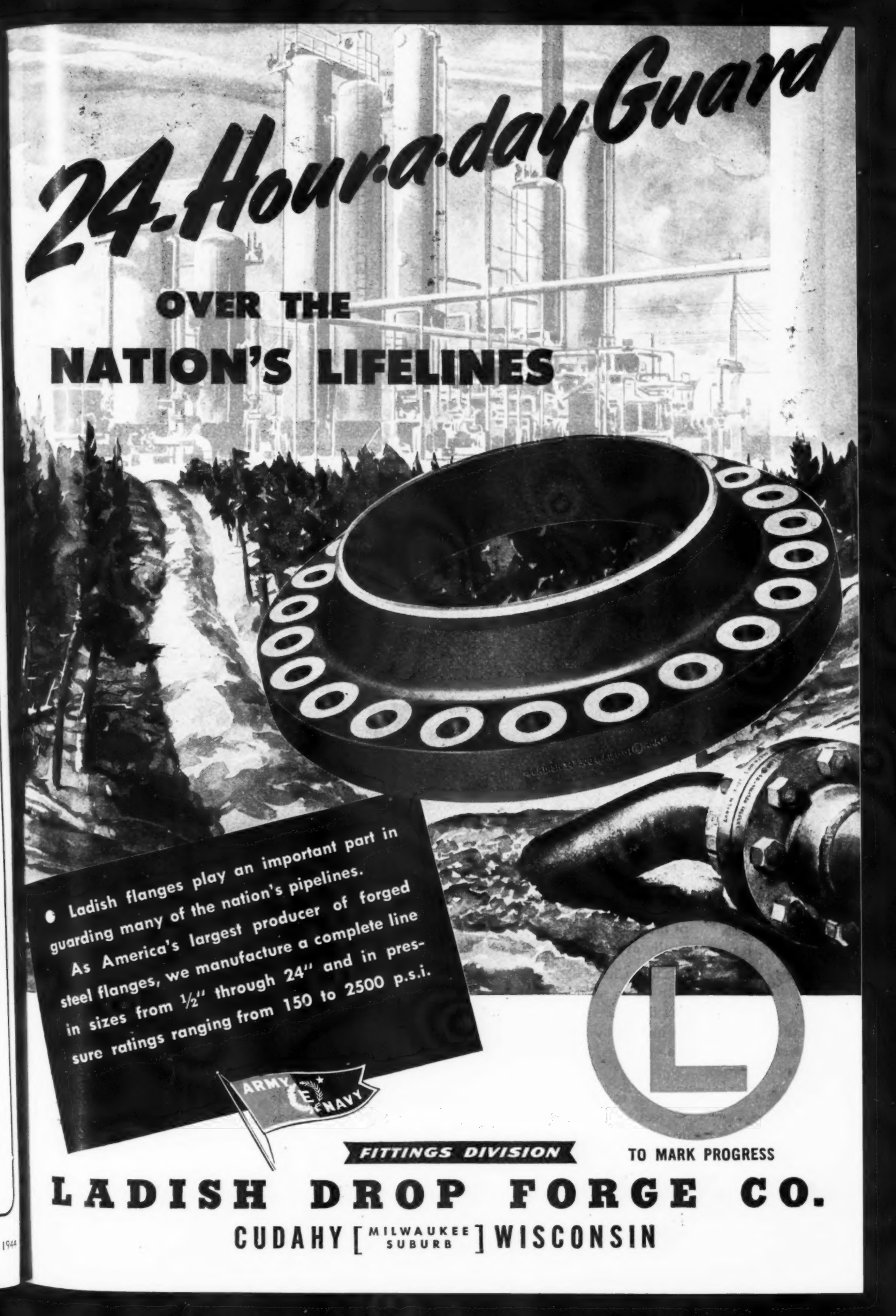
24-Hour-a-day Guard
OVER THE
NATION'S LIFELINES
● Ladish flanges play an important part in guarding many of the nation's pipelines.
As America's largest producer of forged steel flanges, we manufacture a complete line in sizes from ½" through 24" and in pressure ratings ranging from 150 to 2500 p.s.i.
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NAVY
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LADISH DROP FORGE CO.
CUDAHY [MILWAUKEE SUBURB] WISCONSIN

A Big Job Done... but a Bigger Job To Do...

WHEN THE BOYS COME HOME TO STAY

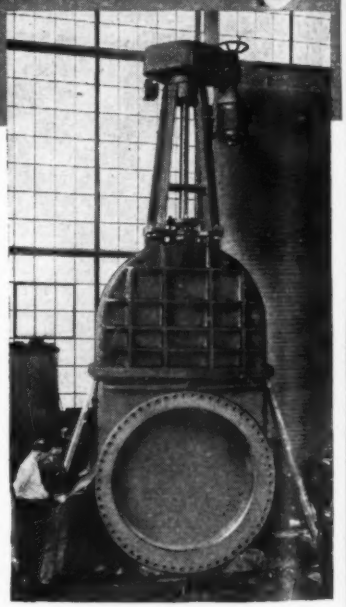
Chapman valves ready for assignment to oil service

Squadron of valves ready for duty on Naval ship

When the war is won, Chapman plants and shops will be given "honorable discharge" from their war-time duties of manufacturing many types and sizes of valves for practically every class of United Nations fighting ship.

Then Chapman will take up the very important work of helping to win the peace... by continuing to supply valves and fittings to synthetic rubber and 100-octane plants... and by turning to meet fully the long-deferred demands of power plants, water works, sewage plants, flood control projects, and oilfield and refinery operations.

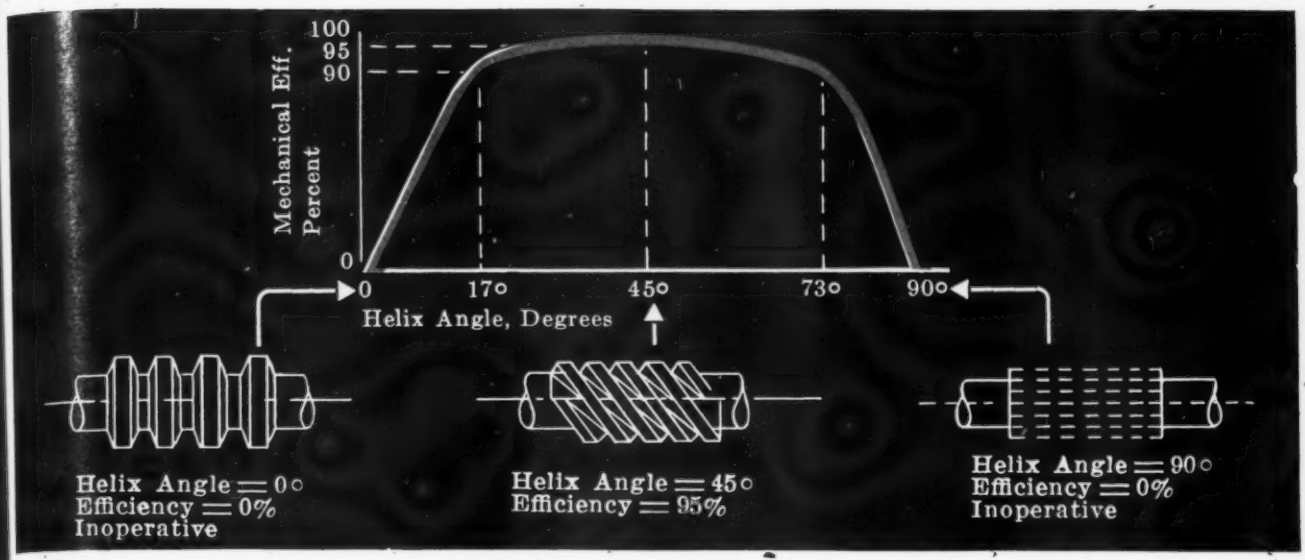
This is the *big* job... to maintain postwar production and employment ... and Chapman faces its own future with well-founded confidence that this job can be done.



This 72", motor-operated valve is to be installed in a drydock project

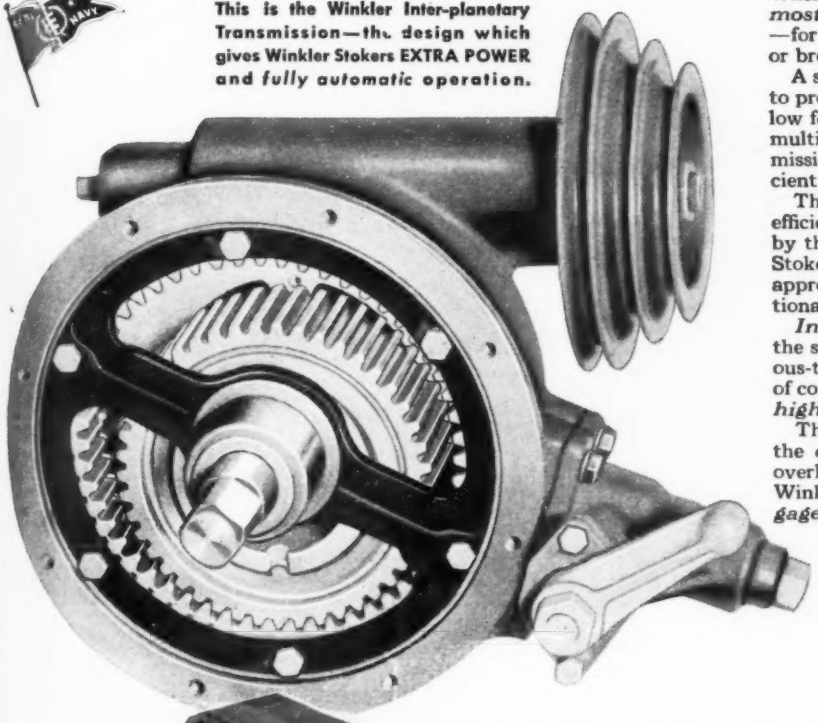
THE **CHAPMAN VALVE** MANUFACTURING COMPANY

INDIAN ORCHARD, MASSACHUSETTS



A CURVE TO GUIDE YOUR STOKER SELECTION

This is the Winkler Inter-planetary Transmission—the design which gives Winkler Stokers EXTRA POWER and *fully automatic* operation.



When specifying stoker equipment, *make the most critical appraisal of the transmission* —for at this point stoker performance is made or broken.

A stoker transmission has two functions. First, to provide a reduction from high motor speed to low feed screw speed. Second, to act as a torque multiplier. In both cases the Winkler Transmission obtains these results with the most efficient design yet developed.

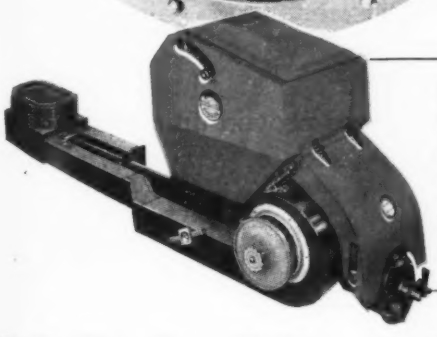
The diagram above shows clearly the high efficiency obtained in the first speed reduction by the 45° worm gear helix used in the Winkler Stoker. With this design, the tooth load is approximately 1/10 of that found in conventional transmissions.

Internal planetary gearing is used to make the secondary reduction and provides a continuous-type drive. Internal gears have a larger arc of contact, which means *less sliding, less wear, higher efficiency and smoother action!*

These are the reasons Winkler Stokers have the *extra power* to overcome usual operating overloads. In the case of extreme overloads, the Winkler Safety Release automatically *disengages and resets* the motor and transmission until the cause is removed. *There is no shear pin in a Winkler Stoker!*

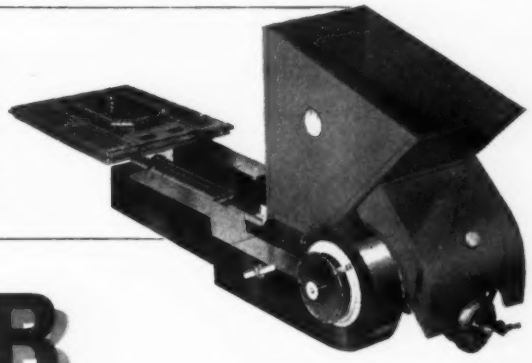
SEND FOR FREE BOOKLET

The above brief description of Winkler Stoker design is fully elaborated upon in a special engineering booklet. Every specifier of coal-burning equipment should read it.



READY FOR DELIVERY *NOW!*

Winkler Commercial and Industrial Stokers are offered through a nation-wide group of distributors and are available for immediate installation. Complete engineering service.

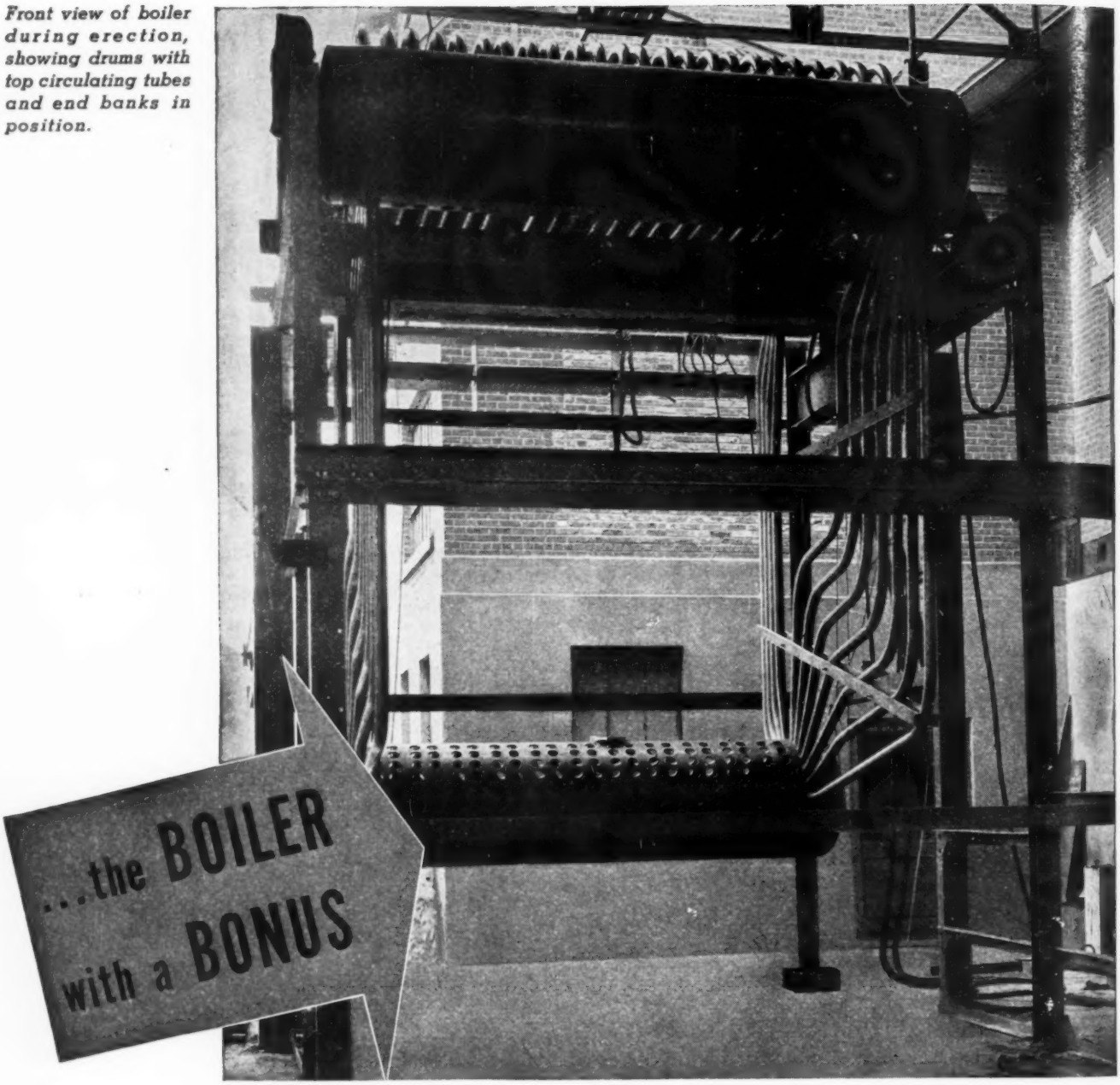


WINKLER

fully automatic STOKERS

U. S. MACHINE CORPORATION • LEBANON, INDIANA

Front view of boiler during erection, showing drums with top circulating tubes and end banks in position.



Here is a three drum EDGE MOOR Radiant Heat Boiler with integral water walls. Banks of specially formed tubes at each end of the front drum are connected to the lower drum to form water walls on both sides of the furnace. There are nc expensive headers, circulating tubes, downcomers or attendant parts to add to initial cost and complicate installation or maintenance. Quick steaming, high ratings, side-wall protection, moderate height, adaptability to any fuel are features of this performance-proved unit.

If you are looking for a boiler that goes beyond the usual standard, write for copy of catalog No. 102.

STEAM GENERATING EQUIPMENT

MAIN OFFICE: EDGE MOOR, DELAWARE
SALES OFFICES: NEW YORK CITY: 30 ROCKEFELLER PLAZA
CHICAGO, ILL.: 1 NORTH LA SALLE ST.

EDGE MOOR IRON WORKS, INC.

EDGE MOOR, DELAWARE.

This is the 6TH *in a series of messages*

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING UNIBESTOS

6a THE PROBLEM
Insulating large pipes (12" to 60")
6b THE SOLUTION
Use Unibestos in ½ sections from 12" to 30" and in ¼ sections up to 60". These large size sections of Unibestos provide an unbroken surface which results in lowered heat loss — higher efficiency.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

GENERAL OFFICES: 1821 S. 54th AVE., CICERO, ILL.
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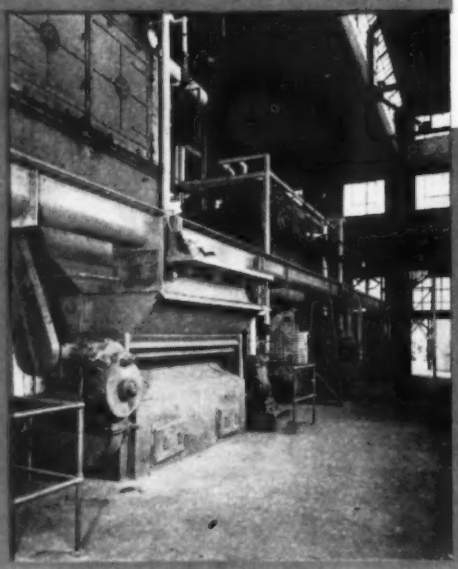
For a constant flow of Coal—
Winter and Summer

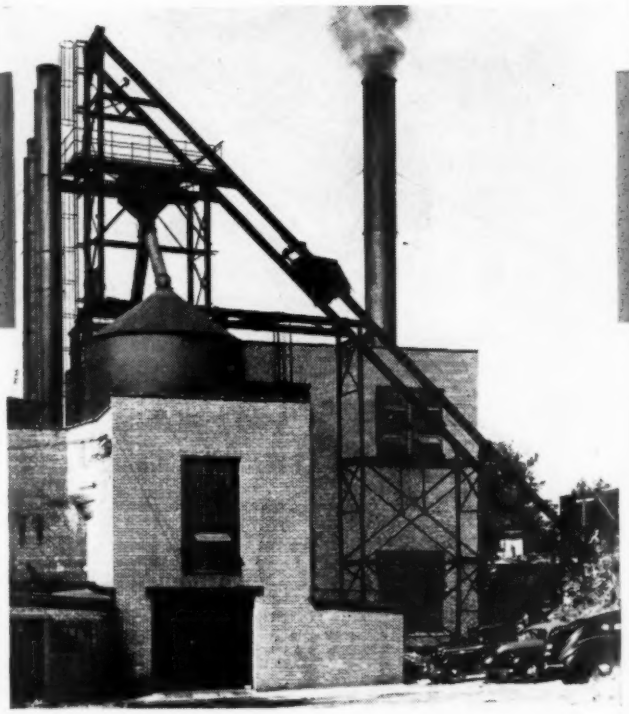
FAIRFIELD SILO SYSTEM

● Aside from providing an efficient and economical method of storage and handling coal mechanically from car to storage or pulverizers—the Fairfield Silo System offers other distinct advantages.

The silos being constructed of vitrified hollow tile provide effective insulation against freezing in cold weather—they will not absorb moisture—coal is protected so loses none of its heat properties—circular construction requires minimum storage space—location outside of boiler house keeps dust and dirt out—furnished in capacities from 100 to 1000 tons.



FAIRFIELD Skip Hoist



● At the right is a typical installation of a Fairfield Skip Hoist handling 50 tons of coal per hour at the plant of a prominent paper mill . . . it distributes the coal to two cylindrical steel bunkers, each having 100 ton capacity. The Skip Bucket has a 60 cu. ft. capacity and 102 ft. lift . . . a two ton motor propelled weight larry delivers the coal to stokers and pulverizers.

THE FAIRFIELD ENGINEERING CO.- MARION, OHIO

BUILDERS OF COAL AND ASH HANDLING EQUIPMENT

It's an L·S·T··· INVASION BOUND!

Official U. S. Navy Photograph

Official U. S. Navy Photograph

BEACH-HEAD ESTABLISHED! *Tanks Ashore!*

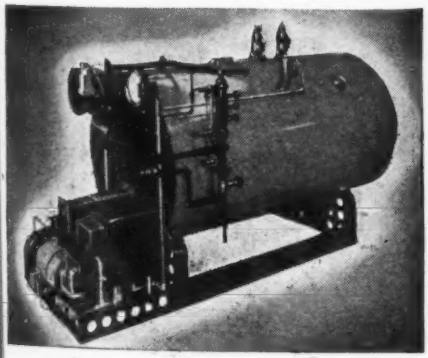
ONE of the most effective and startling types of ships the war has produced is the LST—Landing Ship-Tank.

Born of American ingenuity, these formidable and sea-worthy craft carry American fighting men, supplies, tanks, half-tracks and other mechanized equipment to enemy shores in all corners of the world—Attu, Rendova, Sicily, Kiska, Munda, New Guinea.

Conceived wholly for transport and combat, every inch of space aboard an LST is put to use. These ships cruise from tropic to frigid seas—where ample ship-heating facilities are indispensable. Because Cleaver-Brooks steam generators are exceedingly compact and highly efficient in use of fuel-oil, they are in service aboard LST's—providing necessary steam for heating as well as hot water for the galley and hygienic needs of the men on board. Factory "packaged," finished and tested in every detail—compact, space-saving design—high fuel-to-steam efficiency—quick steaming capacity—dependable 'round the clock performance—these advantages of Cleaver-Brooks steam generators *qualify* them for "combat" duty. Other Cleaver-Brooks equipment in action with our armed forces include portable water distilling units, sterilizers, disinfectors, tank-car heaters, bituminous boosters, and steam generators installed at bases at home and abroad.

Whatever your present or future need for efficient heat generaring and utilizing machines—steam generators, steam processing equipment, automatic steam plants, tank-car heaters, bituminous boosters—write us now for complete information in anticipation of the time when normal conditions return.

Cleaver-Brooks steam generator of the type used aboard LST's—for heating the ship—providing steam and hot water for the gallery and hygienic needs of the crew and military personnel.



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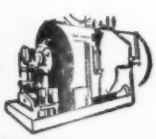
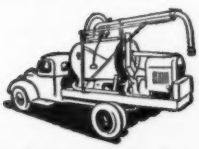
Cleaver-Brooks



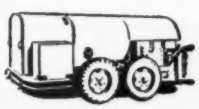
Steam Generators

Food Processing Equipment

Tank Car Heaters



Bituminous Boosters



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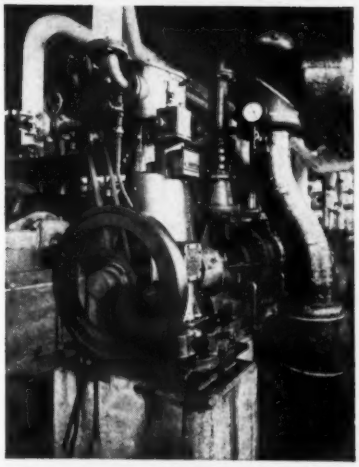
TROY ENGINE & MACHINE

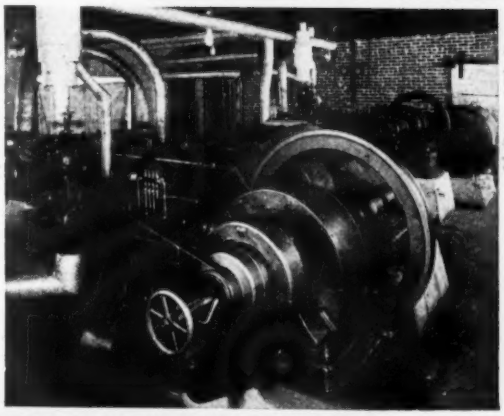
and Dependable of Drives



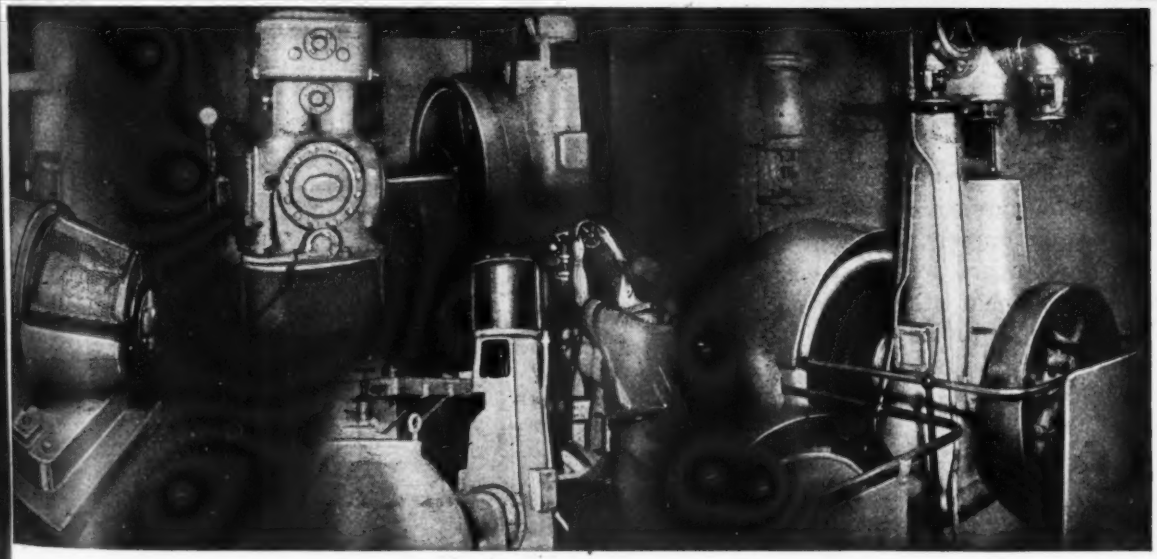
HOWEVER you look upon the economics of a drive—cost per kwh, return on investment, pay-off period . . . you will find that the modern Troy-Engberg Steam Engine rates up with any drive. If the plant heat balances are right, it will rate ahead of any other drive.

As for dependability, that of the steam engine cannot be surpassed by any other. Its very simplicity, ruggedness and relatively low speed are factors. That it is correctly designed and carefully made also contributes to its dependability.

In countless factories and aboard ships of all classes, thousands of Troy-Engberg Steam Engines are driving such equipment as stokers, compressors, fans, generators, blowers, pumps, cookers, and dryers. With a range up to 450 hp (Duplex) and a choice of vertical or horizontal types, there's a Troy-Engberg Steam Engine that is just right for almost *any* auxiliary drive.



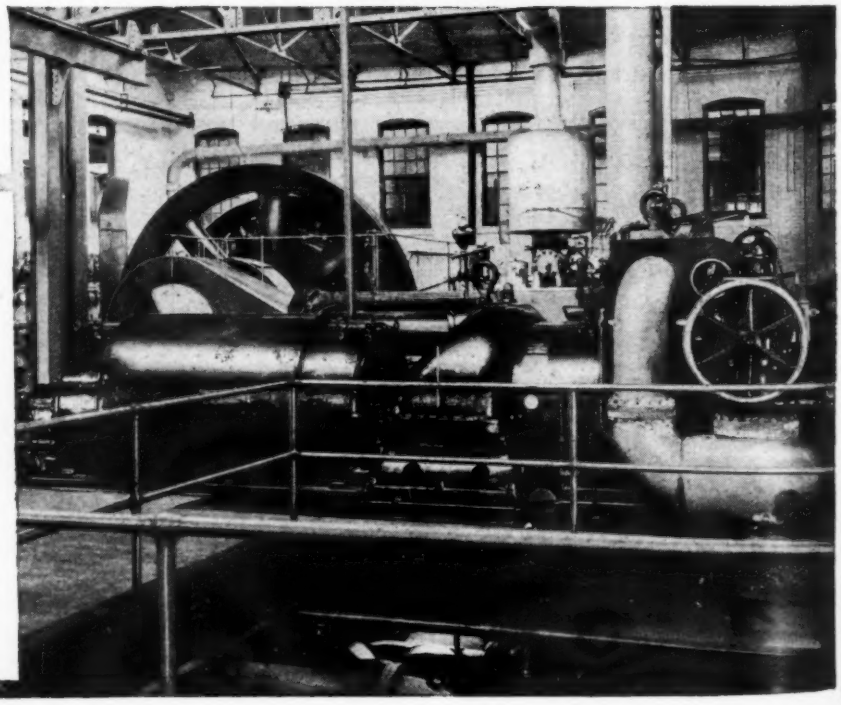
Right now we are busy making D. C. Generating Sets—yes, we make them, too—for the Maritime Commission. However, look over your drives and check places where you might use a Troy-Engberg Engine to advantage. Plan to use live steam for power and the exhaust for processing or heating.



E COMPANY *Established 1870*
1491 RAILROAD AVENUE TROY, PENNSYLVANIA

Official U. S. Army Signal Corps Photograph

AIR ALERT *over there* relies on alertness *here!* To keep *STEAM* plant power output equal to wartime demands use . . .

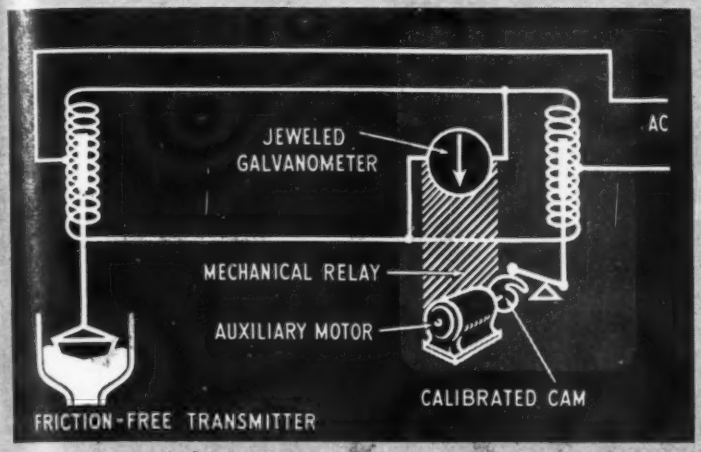


. . . SINCLAIR STEAM CYLINDER and VALVE OILS. These oils are suited to high, low, or moderate pressures and temperatures, and varying engine characteristics. They atomize quickly . . . give *safe* lubrication under all load conditions.

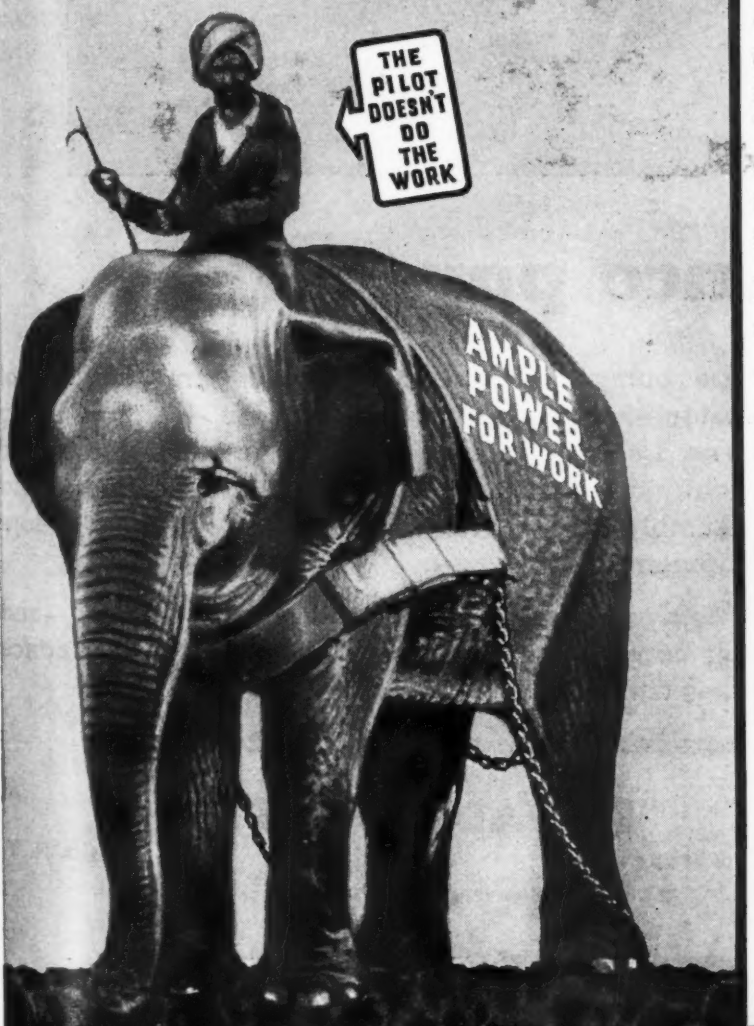
(Write for "The Service Factor"—published periodically and devoted to the solution of lubricating problems.)

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY (INC.), 630 FIFTH AVENUE, NEW YORK 20, N. Y.



In the Cochrane Flow Meter, the Null or Zero Balance principle is employed, balancing the unknown quantity by adjusting a known quantity of the same kind. A highly sensitive detector is used to determine the point of balance. A friction-free transmitter serves as a pilot for an external motor drive. The motor restores the bridge to balance and operates recording pen, indicating pointer, and integrator. The measuring circuit is relieved of all work.



Another Low Maintenance Feature ---the Large Reservoir Pen

The giant glass pen in the Cochrane Flow Meter recorder is another of the many features designed to minimize the amount of attention required in the operation of the meter. The reservoir holds a month's supply of ink. The point is tipped with platinum-iridium, for almost indefinite wear.

For other Cochrane features, see Cochrane Publication 3010. A copy will be sent upon request.

COCHRANE CORPORATION
3120 N. 17th St., Philadelphia 32, Pa.

COCHRANE FLOW METERS

Persistence pays off!

Buffalo Type "RR" Single-suction Multistage Pumps are making performance history in many industrial plants. With single suction impellers mounted back-to-back, practically perfect hydraulic balance is obtained. Bulletin 980 tells the whole story.

Other Buffalo designs—for the chemical plant, the paper mill, the rubber factory and the marine industry are available at present. Write for Bulletins.

Fine pump performance is never an accident of design—nor is it due to design alone. It's more likely to be a combination of good design, accurate manufacturing procedure and careful inspection and assembly—all proven out on the test floor before shipment.

When you insist on all these factors in a pump—and you *can* have them,—you'll find that performance takes care of itself.

There is no better pump than a "Buffalo".

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ARMY E NAVY

"Buffalo"

GENERAL SERVICE PUMPS

What's your welding "KNOW-HOW" on these two metals?

Wrought Iron

1. Q. What filler metal should be used?

A. In welding wrought iron best results are gained by using a standard mild steel filler metal or a rod containing small percentages of alloying elements. These rods are preferred over wrought iron filler metal where welds of high corrosion resistance are required.

2. Q. When the metal first appears molten, is it ready to weld?

A. Fusion of the slag content in wrought iron at about 2100°F gives the metal a deceptive molten appearance. However this is far below the proper welding heat of 2700°–2770°F. Therefore the flame or arc should be applied until a puddle of molten metal appears. This molten puddle should be maintained while filler metal is applied.

Galvanized Steel

1. Q. How may galvanized steel be welded to have a minimum burning away of the galvanized coating?

A. To obtain this result galvanized steel should be oxyacetylene braze-welded with Airco No. 22 manganese-bronze rod, and Airco Hi-Test Brazing Flux. Fusion welding by flame or arc with steel welding rods or electrodes is likely to destroy the galvanizing near the weld and expose the base metal to corrosive attack.

2. Q. How should flux be used?

A. Airco Hi-Test Brazing Flux should be applied to both sides of galvanized parts, and to inside and outside of pipe and fittings. The flux application stops zinc fuming and thus preserves the galvanized coating under the welding heat.

HERE'S YOUR "KNOW HOW" GUIDE FOR WELDING MANY METALS

Procedures for welding most commercial metals are given in the Airco manual, "Welding Procedures". Welding novices and even experts will find much valuable information both on methods and materials recommended for best results. Send for your free copy by filling out and mailing the attached coupon..

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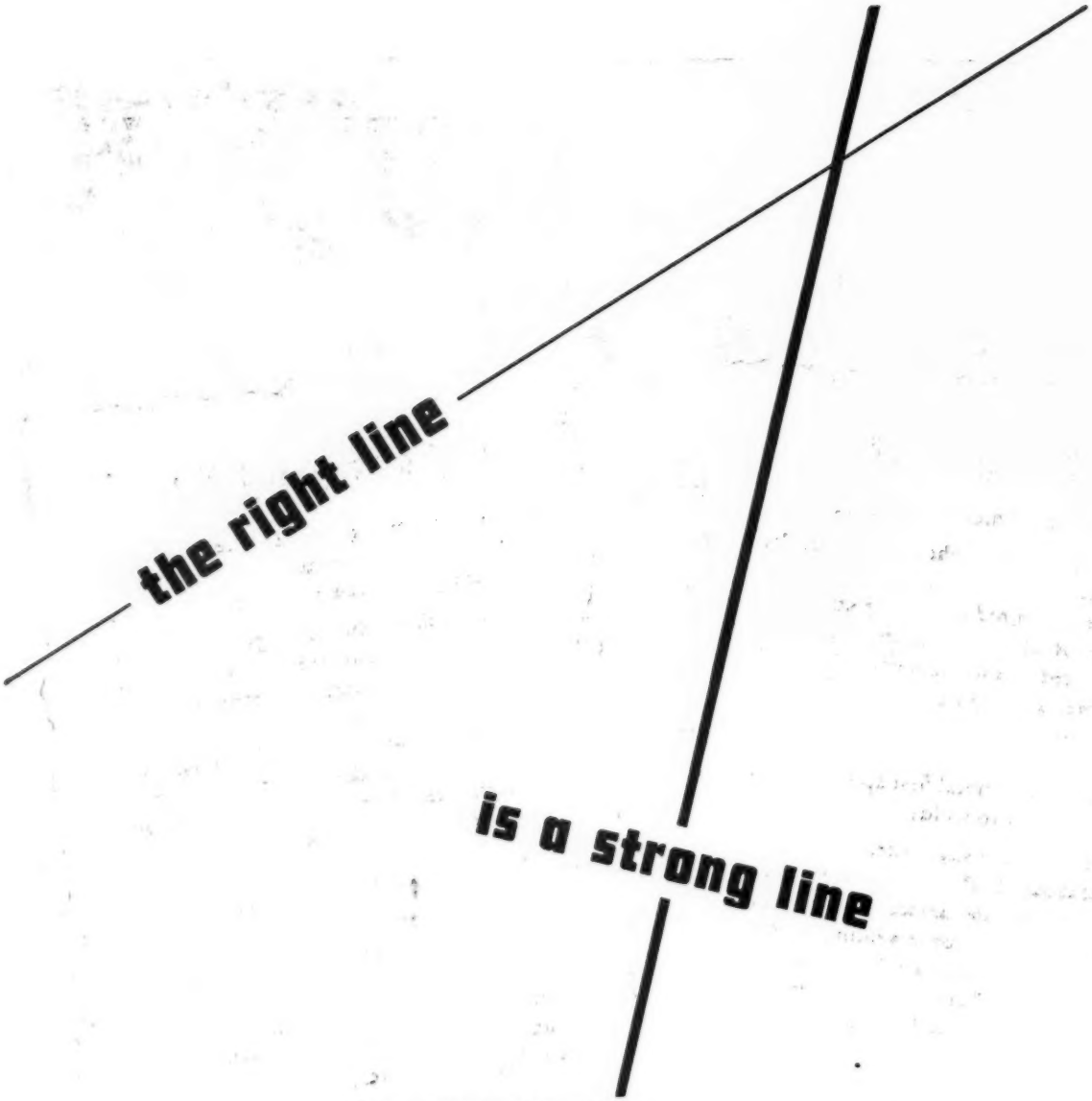
IDLE CYLINDERS ARE PRODUCTION SLACKERS: KEEP 'EM ROLLING FOR VICTORY!



THE NORTON LINE of Refractories is based upon time-tested products plus experienced engineering. Long successfully used by power plant operators are CRYSTOLON (silicon carbide) Brick which withstand extreme heat at peak operation without failing. Their dense surface, resistant to slag penetration, makes clinker removal easy. Rugged, chemically stable and abrasion-resistant, CRYSTOLON Brick guarantee long, trouble-free service. Norton engineers will gladly advise you on the best installation procedure.

NORTON COMPANY • Worcester 6, Massachusetts

NORTON Longer Lasting **REFRACTORIES**

Another CP Steam-Driven Compressor
GUARDS AGAINST POWER FAILURE

This CP Horizontal Duplex, Steam-Driven Compressor, installed in a war plant is safeguarding production against shutdown through power failure of the synchronous motor-driven CP Compressor installed with it.

CP Steam-Driven Compressors are playing their part in the war effort . . . protecting vital war plants against interruption of air supply due to power line failure . . . efficiently utilizing boiler capacity where it is more plentiful than electrical current . . . providing exhaust steam where needed for heating or process work.

CP Steam-Driven Horizontal Duplex, Two-Stage Compressors are ideal for large and medium-size plants. Capacities range from 400 to 6600 c.f.m., 100 to 125 pounds air pressure with steam cylinders available for a wide range of steam conditions. Other sizes in single and multi-stage design for lower and higher pressures. Write for literature.

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TOOL COMPANY
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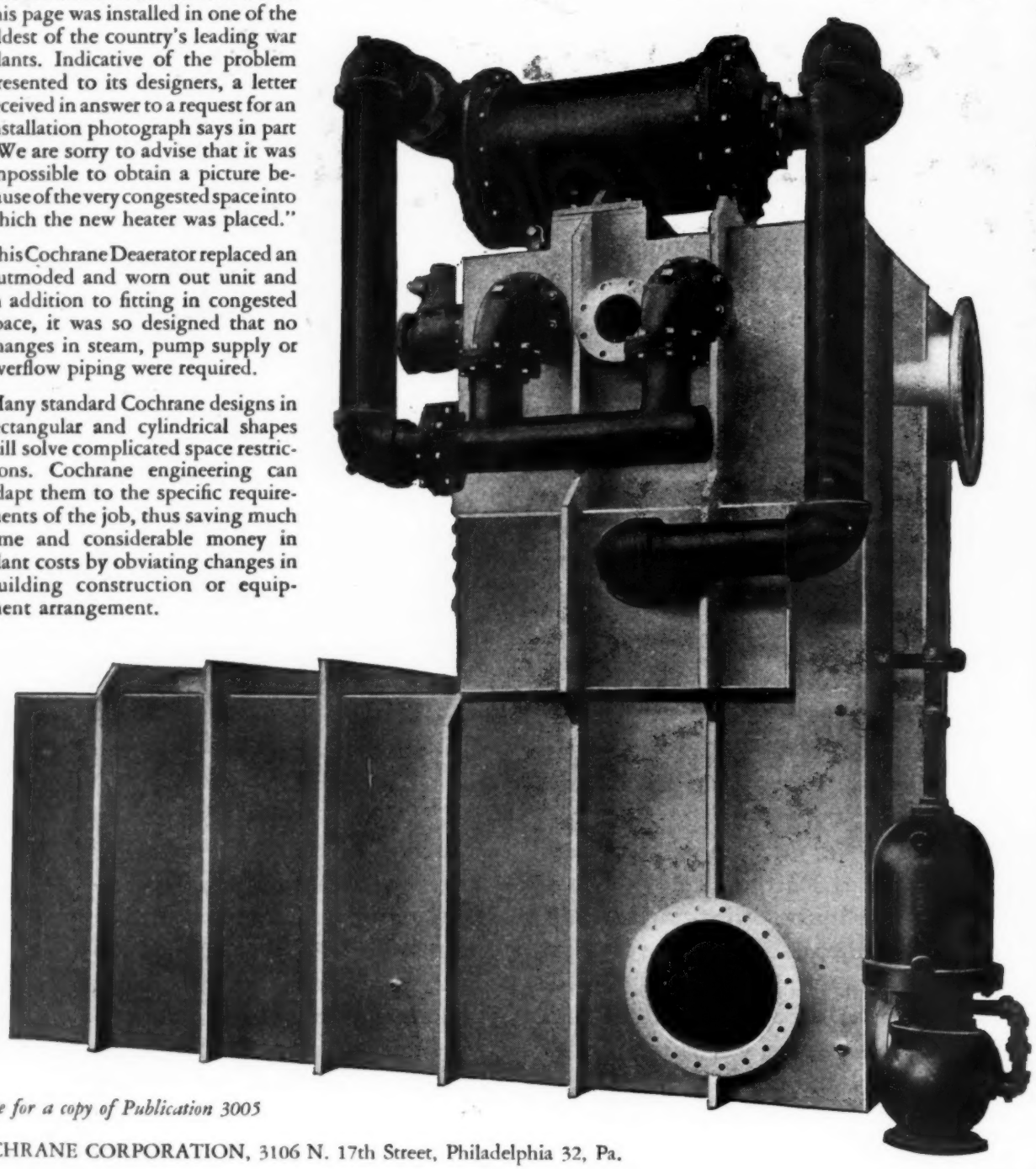
★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

"...very congested space..."

The Cochrane Deaerator shown on this page was installed in one of the oldest of the country's leading war plants. Indicative of the problem presented to its designers, a letter received in answer to a request for an installation photograph says in part "We are sorry to advise that it was impossible to obtain a picture because of the very congested space into which the new heater was placed."

This Cochrane Deaerator replaced an outmoded and worn out unit and in addition to fitting in congested space, it was so designed that no changes in steam, pump supply or overflow piping were required.

Many standard Cochrane designs in rectangular and cylindrical shapes will solve complicated space restrictions. Cochrane engineering can adapt them to the specific requirements of the job, thus saving much time and considerable money in plant costs by obviating changes in building construction or equipment arrangement.

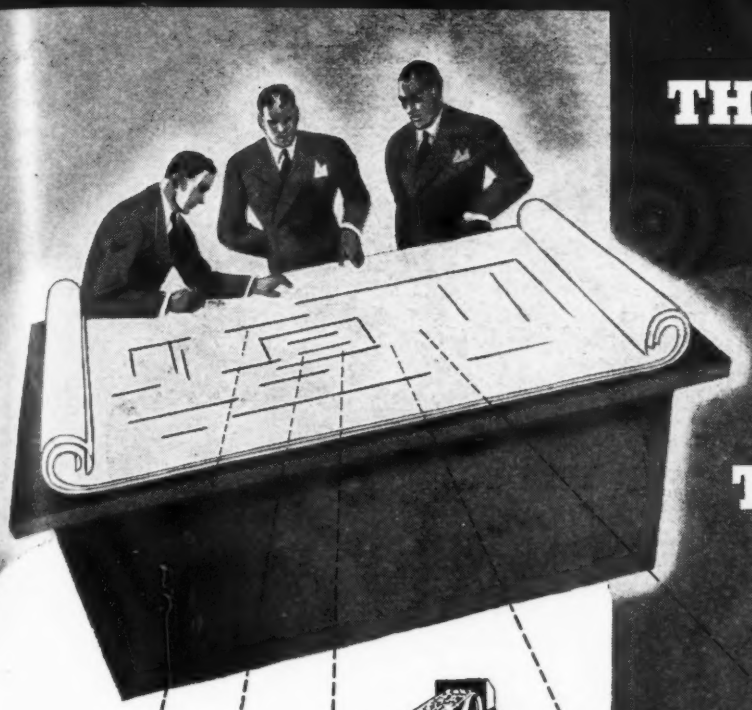


Write for a copy of Publication 3005

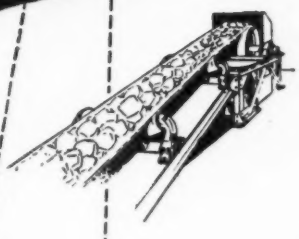
COCHRANE CORPORATION, 3106 N. 17th Street, Philadelphia 32, Pa.

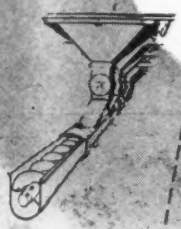
COCHRANE

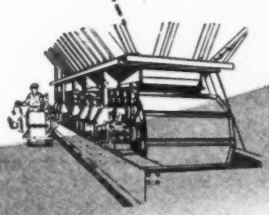
SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

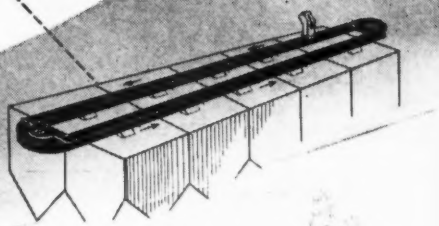


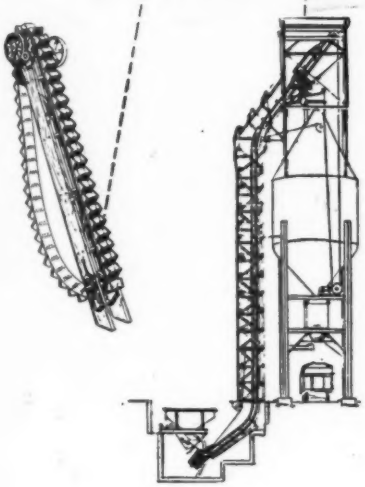
THE *Right* METHOD THE *Right* EQUIPMENT











S-A Engineers Consider All Types of Material Handling Equipment

● Material handling is so critical a part of virtually every industrial operation that no plant man will want to make a decision on equipment until he is convinced that the system recommended is the exact system needed for maximum efficiency and economy.

Consult S-A Engineers on your current or post-war handling problems, as they are in a position to give you the benefit of 42 years of experience in the solution of your Material Handling problems.

Stephens-Adamson designs and manufactures all types of conveying units required in any recommended systems

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STEPHEN S-A ADAMSON MFG. CO.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

MOGUL METALLIZING SOLVES MAINTENANCE PROBLEMS

Your machine parts are wearing out faster than ever before under grueling war-time production schedules. Your replacements mean costly delays. You are also finding that many of your machine parts can't be had for love nor money!

That's where Mogul Metallizing fits in—rebuilds worn and discarded parts at a fraction of the cost—with a minimum loss of time. In fact many parts can be metallized without dismantling of machines.

These guns are today effecting amazing economies not only in maintenance, but corrosion prevention and production applications as well. It's the gun that's carrying on the big fight behind the lines.

Salvage Worn Parts

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36 pages of money-saving applications, a veritable encyclopedia of techniques and practices classified by industry. Reserve your copy right away.

MOGUL

The Mogul Model P Metallizing Gun is the most perfectly engineered unit available today. Its performance cannot be equaled. Fewer parts guarantee years of life and trouble-free high speed operation.

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Executive Offices: Dept. P, 1330 Congress Street, Chicago, Ill.—Eastern Office: 135 Cedar Street, New York, N. Y.

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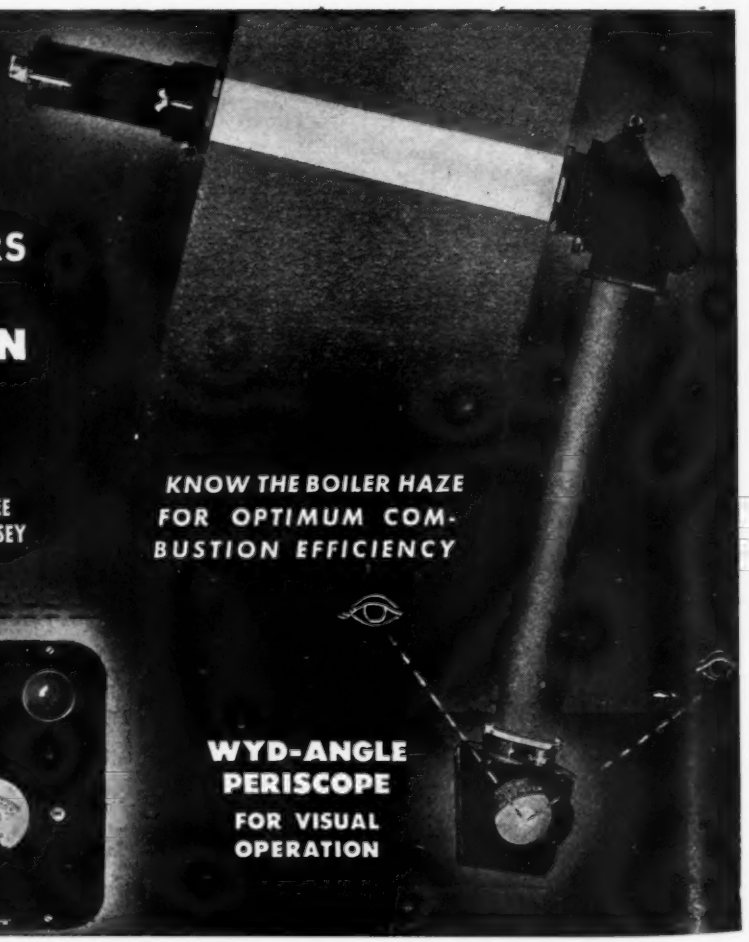


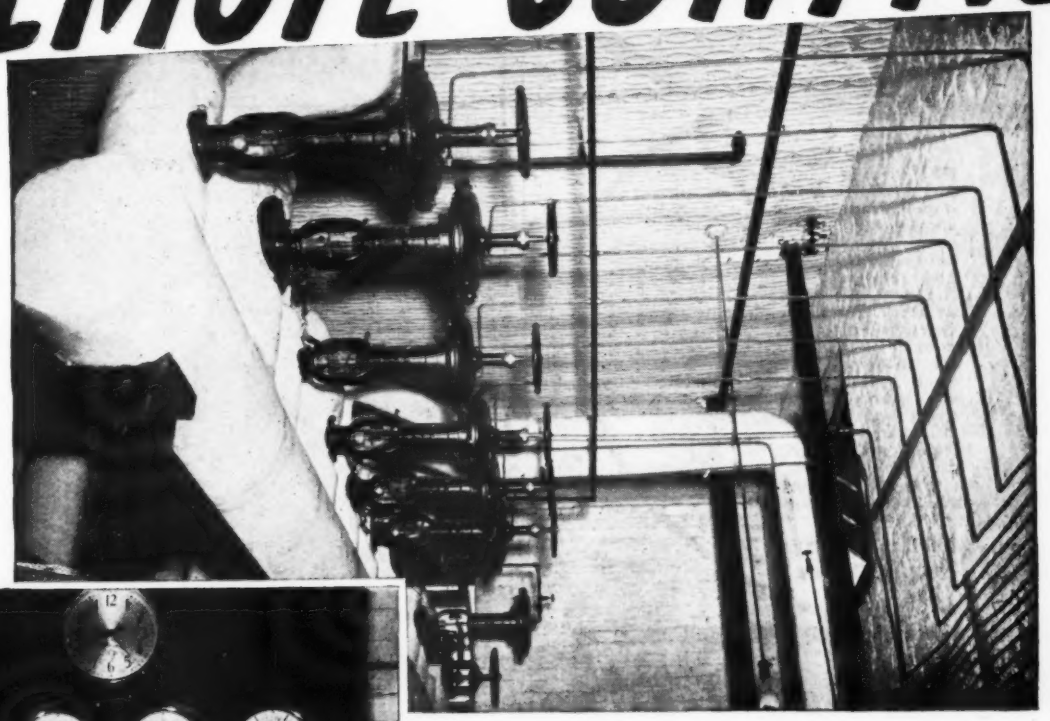
KNOW THE BOILER HAZE FOR OPTIMUM COMBUSTION EFFICIENCY

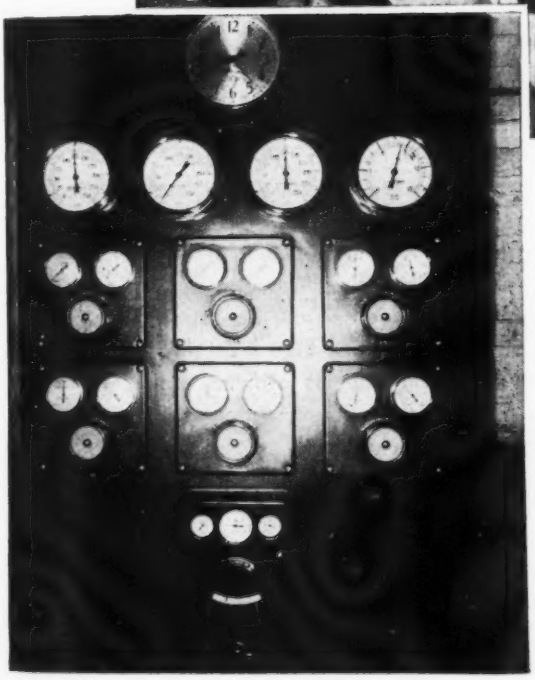
ELECTRONIC HAZEGAGE
FOR AUTOMATIC SIGNAL OPERATION

WYD-ANGLE PERISCOPE
FOR VISUAL OPERATION

WRITE FOR CATALOG P

REMOTE CONTROL





All Fisher diaphragm motor valves are designed and manufactured particularly for pilot valve actuation. They provide full throttling control and react accurately and promptly in accordance to the dictates of the remote mounted pilots. Complete information about Fisher Diaphragm Motor Valves and Fisher Pilot Valves will be furnished on request.

Our increased manufacturing facilities, plus new and improved methods, resulting from our all out War Effort have greatly stepped up the production of Fisher Automatic Controllers. Consequently, we are now in a better position to invite your inquiries on general industrial automatic control requirements.

STEAM PRESSURES ACCURATELY CONTROLLED BY FISHER DIAPHRAGM VALVES ACTUATED BY PANEL MOUNTED FISHER PILOT VALVES . . .

These modern power plant illustrations show an excellent example of remote control of steam pressures for heating and processing purposes.

The Fisher Diaphragm Motor Valves shown above are installed in the steam lines from the main header, and are actuated by the Fisher Pilot Valves mounted on the panel board illustrated at left. Hand jacks have been supplied for manually positioning or manually closing the inner valves when necessary. This installation gives the operator literal "finger-tip" control of steam pressures to all parts of the plant.

For this service Fisher Diaphragm Motor valves can be furnished with single port bodies for tight shut-off or for normal throttling control they may be equipped with double ported V-Port or Plug type inner valves.

★

FISHER GOVERNOR COMPANY, 430 FISHER BLDG. **MARSHALLTOWN, IOWA**

X-PANDO PIPE JOINT COMPOUND ACTUALLY STRENGTHENS THE JOINT

Used by U. S. Army, U.S. Navy, U. S. Army Air Corps, U. S. Maritime Commission

Here's a pipe joint compound that *EXPANDS as it SETS*—correcting imperfections in faulty threads and flanged faces – strengthening every joint – preventing leaks permanently. Better than litharge and glycerine for all uses. X-Pando (the one formula) holds *anything* carried in metal pipe except certain heavy acids. Economical. Remember, *one formula* for all uses! Expands and contracts with pipe movement. Resists vibration, deflection, sharp temperature changes, pressures. Withstands deflection – joints sealed with X-PANDO may be easily taken apart. Standard pipe compound in American industry and in the Shipbuilding field.

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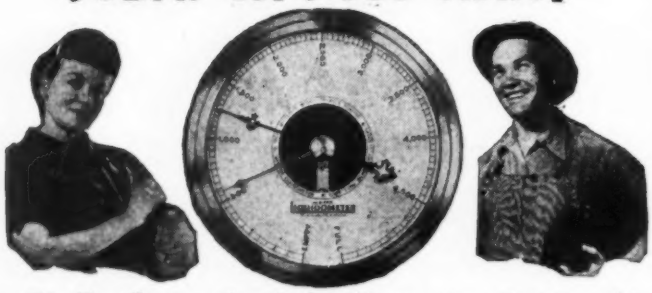
TODAY OR POST-WAR!



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LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.
No pumps, valves, or auxiliary units needed to read them.
Models available for either remote or direct readings.
Accuracy unaffected by specific gravity of tank liquid.
Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

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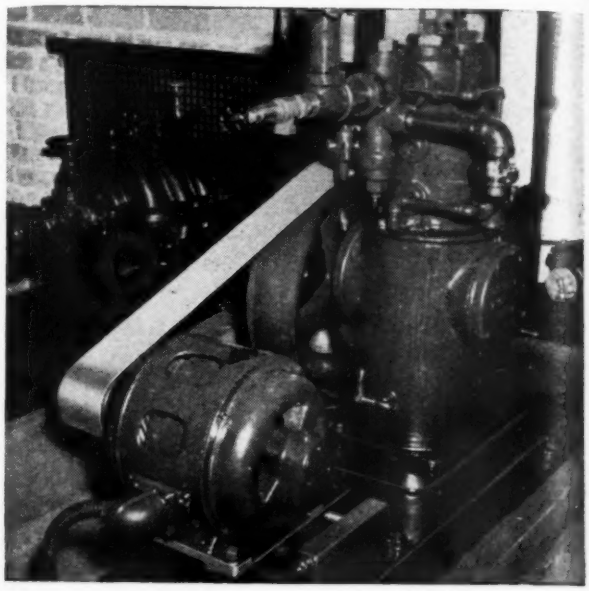
IT TAKES A LONG TIME TO TRULY EVALUATE BELTING ECONOMY



That's why plants that have used Tannate Leather Belting for years are most enthusiastic about the long, trouble-free service it gives. Tannate keeps machines running steadily at top speeds with little time out for repairs even where 3 shift—7 day a week operation is maintained. It is stronger than most first quality oak belting and outlasts ordinary belts. Further, it is resistant to moisture, machine oils and many weak chemicals.

Rhoads Engineering advice may show you the way to get real economy—with Tannate.

STEP UP PRODUCTION with
RHOADS *Tannate*
WATERSHED LEATHER BELTING

Established 1702

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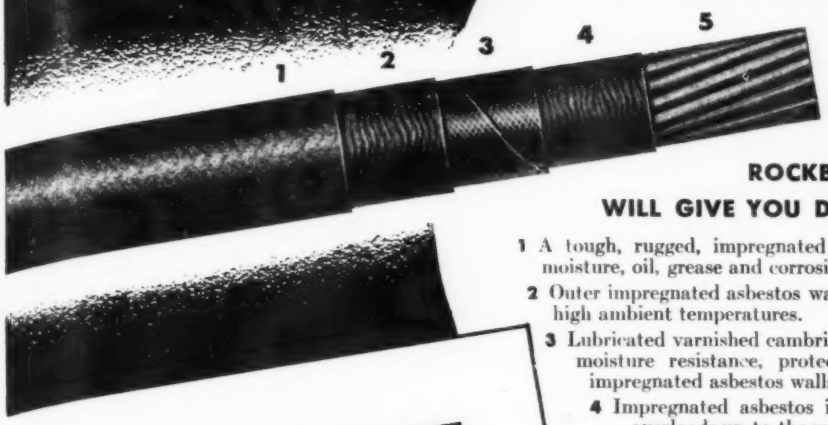
NEW YORK • CHICAGO • ATLANTA • CLEVELAND

INSTALL POST-WAR WIRE NOW

Rockbestos A.V.C. Power Cable below and similarly insulated Motor Lead Cable (Underwriters' and Nat. Elec. Code, Type AVA) has a maximum operating temperature rating of 110°C. (230°F.) and a permanently insulated construction. See detail to the right.

For Long-Life in Circuits Exposed to Severe Conditions



WHY PERMANENTLY INSULATED ROCKBESTOS A.V.C. WILL GIVE YOU DURATION-PLUS SERVICE*

1 A tough, rugged, impregnated asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

2 Outer impregnated asbestos wall which serves as a heat-barrier against high ambient temperatures.

3 Lubricated varnished cambric for high dielectric strength and added moisture resistance, protected from heat and flame by two impregnated asbestos walls.

4 Impregnated asbestos insulation withstands the heat of overloads up to the melting point of copper and won't ignite or burn.

5 The conductor is perfectly and permanently centered in helically applied insulation.

**One of 122 different wires and cables developed for severe operating conditions.*

ROCKBESTOS A.V.C. 600 VOLT MOTOR LEAD CABLE
(Underwriters' Type AVA)

Sizes No. 18 AWG to 1,000,000 CM insulated with two walls of felted asbestos and a high-dielectric, heat-sealed varnished cambric insert, covered with heavy asbestos braid.

Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible. For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.

ROCKBESTOS A.V.C. 600 VOLT SWITCHBOARD WIRE
(Underwriters' Type AVB)

Sizes No. 18 to 4/0 AWG with varnished cambric and felted asbestos insulation and gray, black, white or colored flameproof cotton braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is absolutely fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A.V.C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.

ROCKBESTOS INDUSTRIAL HEATING CABLE

No. 19 AWG nickel-chromium wire insulated with .040" of felted asbestos and covered with 4/64" waterproof lead sheath.

This pliable cable distributes a mild heat evenly over a large area. Prevents freezing of water pipes, wet pipe sprinkler systems, etc. Keeps conveyor pipes for fuel oil, soap, varnish, ink, chocolate, etc., at temperatures that insure steady flow.

WON'T bake brittle, burn, flow or rot.

RESISTS moisture, oil, grease and fumes.

Are you troubled with wire-failures in circuits that run around "hot-spot" locations such as furnaces, lehrs, boilers, steam tunnels, etc.? Do they seem to happen much too often? Then install Rockbestos A.V.C. *permanently insulated* wire and cable. It will not only give you freedom from wire failures for the duration, but will continue to provide trouble-free, dependable service for years to come.

Why does Rockbestos stand up? Because it has a *permanent impregnated asbestos insulation* that resists heat, flame, moisture, oil, grease and alkalies . . . and won't bake brittle, crack, bloom, rot, flow or swell. Start planning for the future as well as the present—install Rockbestos A.V.C. and forget your wire problems.

When inquiring or ordering, please furnish CMP allotment number or symbol with proper certification. For particulars and samples write nearest branch office or Rockbestos Products Corporation, 931 Niéoll Street, New Haven 4, Connecticut.

FOR VICTORY

★ ***Invest in United States War Bonds*** ★

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The Wire with Permanent Insulation

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the pipe wrench that stays

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The only wrench with housing guaranteed not to break or warp

●That famous RIDGID housing guarantee assures you far more than replacement of the housing free if it ever breaks or warps. It means that millions of these wrenches in service have proved that nothing goes wrong with the housing—and the wrench stays on the job. No housing repair expense, no tools out of service, fewer spares needed. You'll like also the adjusting nut in open housing that always spins easily to pipe size—and the handy pipe scale on hookjaw—and the comfort-grip I-beam handle. Keep work up, costs down—ask your Supply House.

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Pipe Wrenches, Cutters, Threaders, Vises

Fast-Working Tools for War.. and the Busy Peace Ahead

Are you equipped to hold your job?—to get a new one?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of Job Insurance there is—KNOWLEDGE.

How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books?

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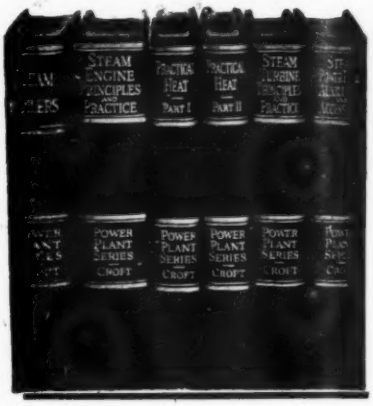

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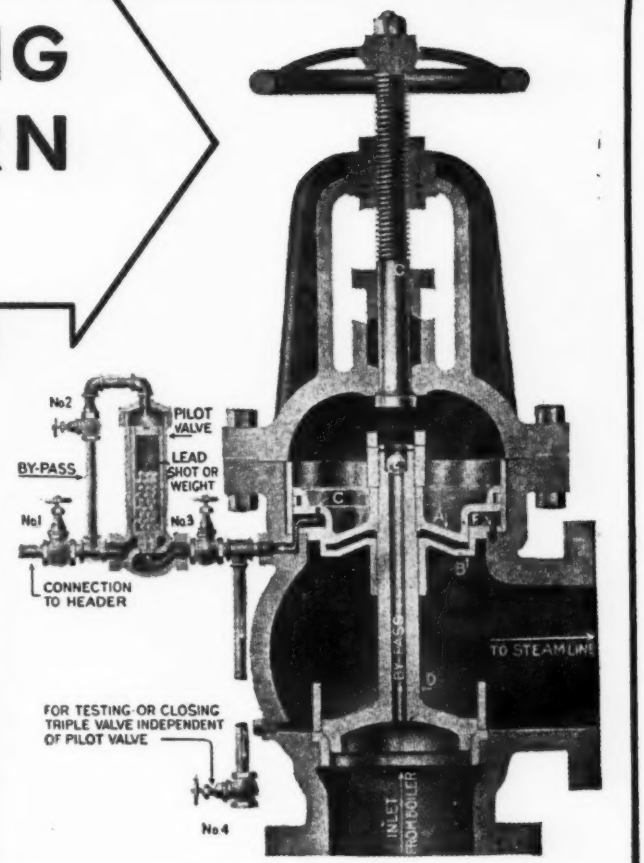

● Here is capacity . . . ability to hold adjusted pressures . . . safe, positive action . . . automatic life and property protection—all in one unit! The G-A Triple-Acting Non-Return Valve offers *independent, automatic* protection against line-ruptures or explosions by "cutting in" a boiler whenever boiler pressure equals line-header pressure . . . and *isolating* the boiler whenever its pressure is lower than line-header pressure.

A further advantage offered by this valve is the fact that it will prevent steam flow from the boiler if there is a sudden drop of line-header pressure below boiler pressure.

Equip your boiler room with this valve! It will assure absolute safety for your operations . . . prevent service troubles and "down time". Complete, specific application and operation data on the complete line of GOLDEN-ANDERSON Specialty Valves is contained in our latest catalog. Write for your copy today. No obligation.

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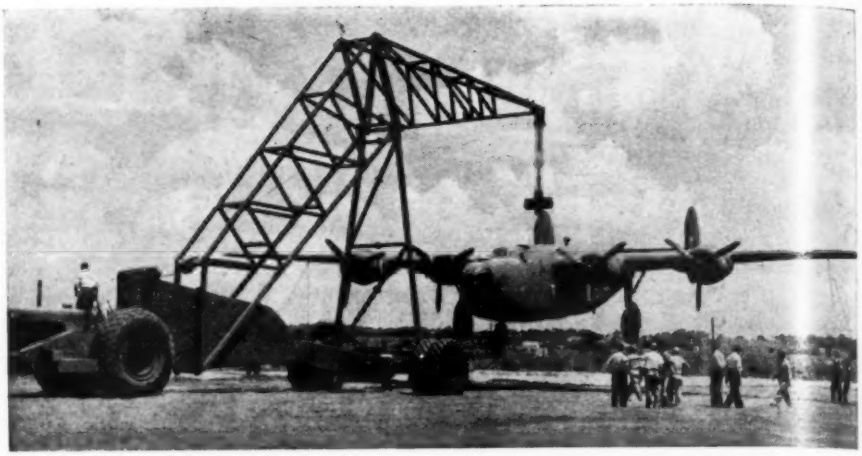
Clearing Airfields for ACTION!

... with a Bomber TOURNACRANE powered by Cummins Diesel, equipped with NUGENT FILTERS.



Here's a B-30 (Bomber) Tournacrane being put through its paces in recent Army tests. It is used to demonstrate how runways and airfields may be cleared of crashed planes by merely picking them up and carrying them away.

Nugent Fuel Oil Filters help keep the Cummins Diesel, which powers the Tournacrane, operating with maximum dependability.

Throughout many industries Nugent filters and oiling devices are helping to conserve both lubricating oils and fuel oils. Perhaps we can help you on your specific problems. Write today for latest bulletins.

At the left is a Nugent Pressure Filter of the type used on Cummins Diesels to keep fuel oil lines clean. Patented design and construction gives this unit 468 sq. in. of filtering area.

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FUEL OIL HEATERS

Preheat for More Heat

The Whitlock Type V-1 Oil Heater shown above is of a simple standard design at moderate cost. It has seamless steel tubes and welded construction, adapted to high working pressures.

Whitlock Fuel Oil Heaters of more elaborate design are made to suit individual operating conditions and engineered for any combinations of temperature rise, operating pressure and capacity. Incorporating Whitlock's experience of many years in the fabricating of such equipment, they guarantee a unit to suit your requirements for economy and efficiency.

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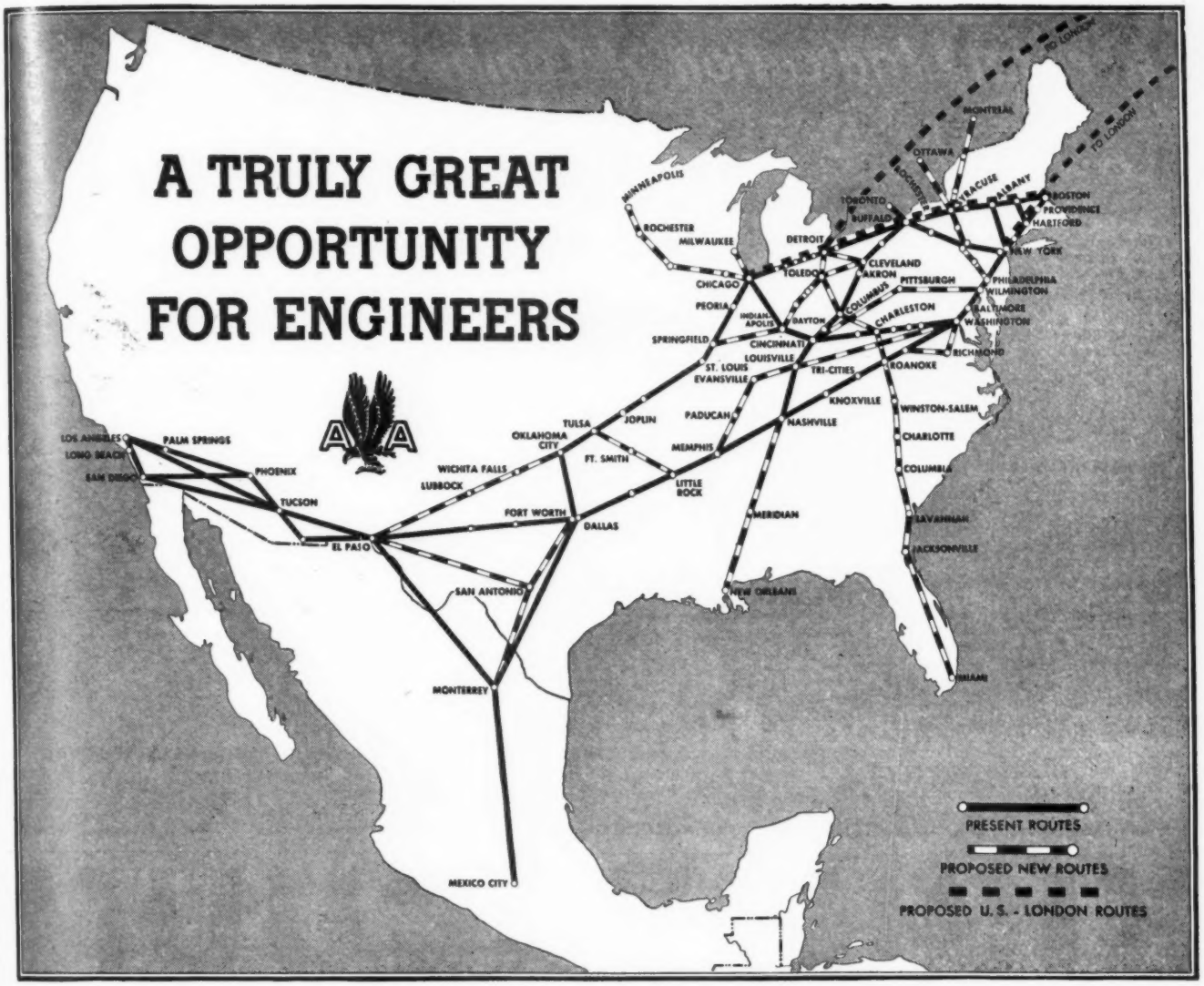
Authorized representatives in other principal cities—consult local telephone directory under our name.

Whitlock Equipment (Whitlock-Darling) is manufactured in Canada by Darling Brothers, Ltd., Montreal.



THE map shown above is more than a map. It is a picture of one of the greatest opportunities ever offered to engineers. For it is the American Airlines system map, showing the present and the proposed new Routes of the Flagships.

The organization that operates passenger, mail and cargo airplanes over the current vast routes is seeking men for positions in its Engineering Department at La Guardia Field in New York. Men sparked by vision and ambition will be quick to see that here is not only the chance to take an active hand in vital war work, but get a head start toward a limitless peacetime future as well.

Air transportation is one business that surely is going to expand after the war. Here is your opportunity to help, and to grow with American Airlines.

Aeronautical experience is not required. If you have had at least two years of experience in the design or servicing of tools, machines or mechanical devices in mechanical, electrical or aeronautical fields, you can qualify. Candidates accepted will be given a full course in aircraft familiarization. Length of course and starting salary will depend on your experience.

Today, write the Personnel Department of American Airlines, Inc., at the address below, giving your past experience and detailed personal information, including draft status.

AMERICAN AIRLINES *Inc.*

PERSONNEL DEPARTMENT, SECTION "E," 100 EAST 42nd ST., NEW YORK 17, N. Y.

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Accurate Indication of Combustion Conditions

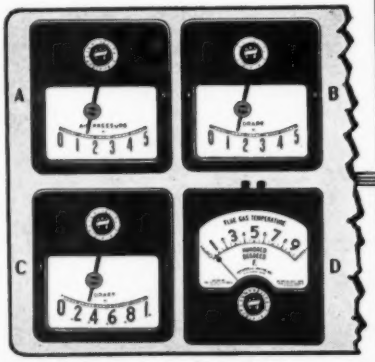
AT SURPRISINGLY LOW COST . . . BY HOTSTREAM

These gages tell you at all times exactly what you need to know about your furnace or boiler to insure efficient operation. Although highly accurate and dependable, they are inexpensive — and quickly pay for themselves in fuel savings.

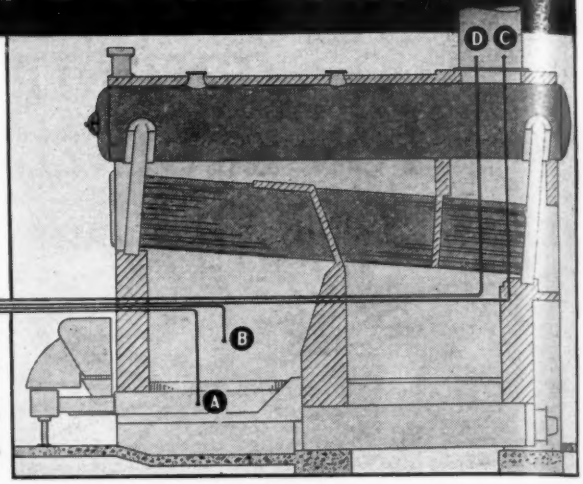
A HOTSTREAM PRESSURE GAGE— indicates undergrate pressure, warns of impending blow-holes, clinker formations, and failing fuel bed. Makes possible accurate synchronizing of coal and air to insure ideal fuel bed.

B HOTSTREAM DRAFT GAGE— indicates quantity of air furnished for efficient fuel burning. Makes possible accurate adjustment of "fuel-air ratio," and proper control of draft mechanism.

C HOTSTREAM DRAFT GAGE— indicates stack draft available at all times. An ideal installation also uses DRAFT GAGES to indicate draft available after first, second and last pass — offering comparative readings to show efficiency of heat transfer and diminished draft caused by soot.



D HOTSTREAM THERMOGAGE — electrically indicates temperatures of flue gases at boiler outlet, and offers a final check on degree to which boiler has absorbed useful heat.



Typical installation showing Hotstream gages indicating combustion conditions for efficient operation.

AGENTS: Several attractive territories are still open. Write for complete information.

Combustion Equipment Division

THE HOTSTREAM HEATER COMPANY

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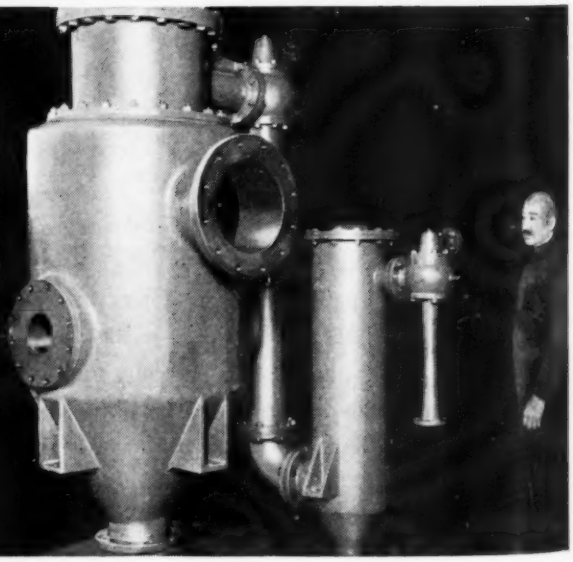
SURFACE CONDENSERS · EVAPORATORS · FEED WATER HEATERS · LUBE OIL COOLERS · EXCHANGERS

. . . when you buy a Graham product . . . you have eliminated all experiment . . . it will perform because . . . you have purchased 25 years of practical engineering experience plus . . . the best of workmanship and material . . . backed by a Company . . . whose earnest desire is . . . to cause you to buy again

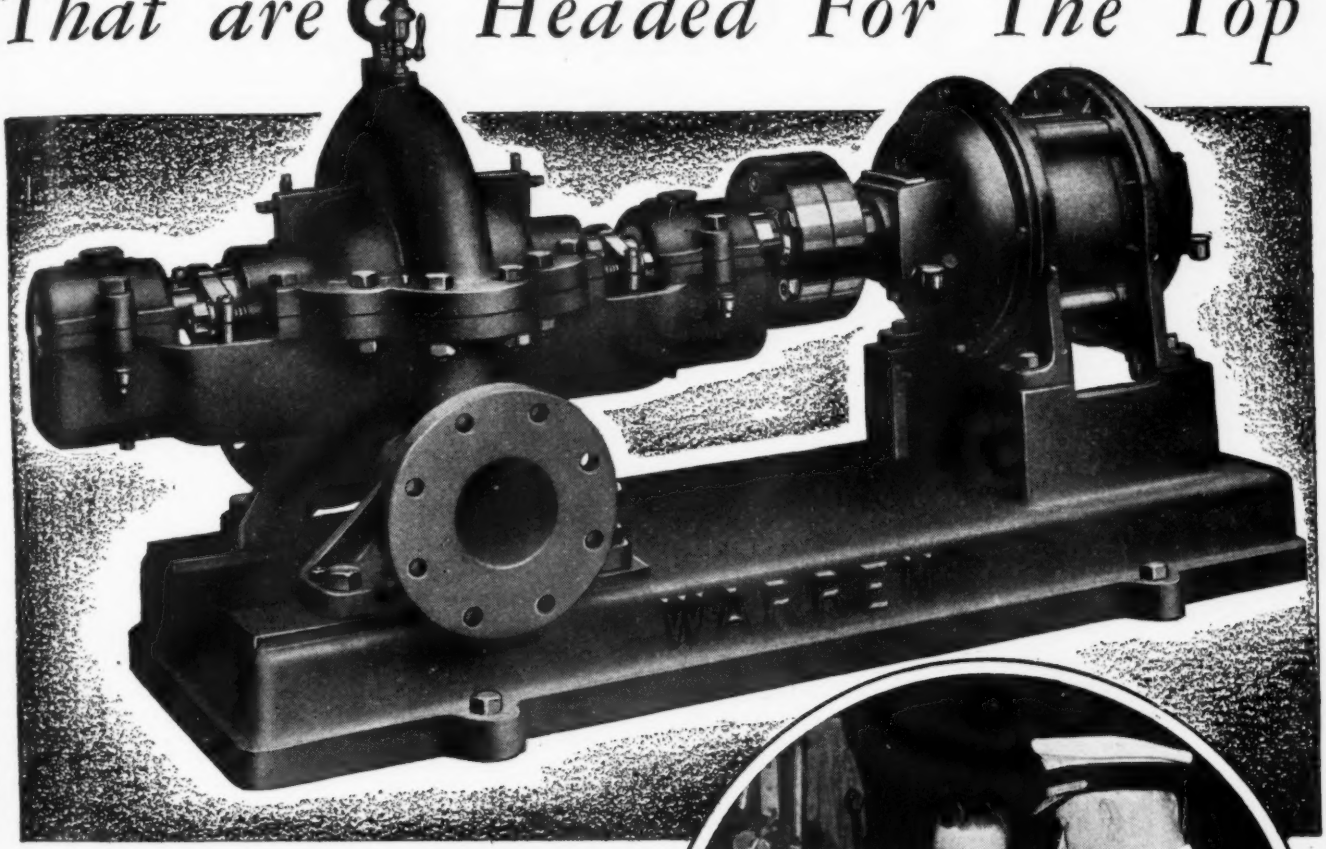


GRAHAM MANUFACTURING CO., INC.

415 LEXINGTON AVE., NEW YORK 17, N. Y.

POST-WAR PLANNERS—

. . . Here Are Other Warren Pumps That are Headed For The Top



WARREN SINGLE STAGE • DOUBLE SUCTION

CENTRIFUGAL PUMPS

TYPES DB AND DS

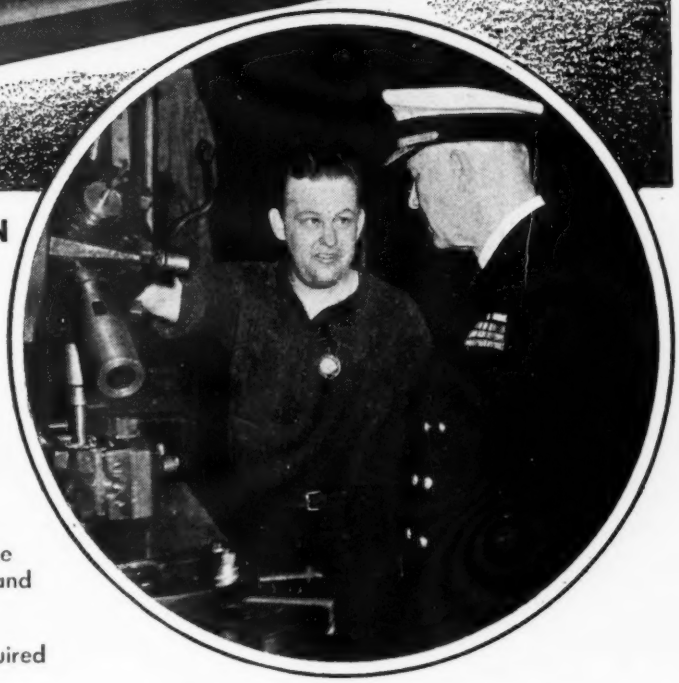
As an initial insight into the character of these Centrifugal Pumps, here are a few of their specifications:

Casing: — Close-grained, high test cast iron of the double suction, volute type divided on the horizontal center-line.

Impeller: — Gun bronze composition and of the double suction, enclosed type, accurately machined and balanced to insure freedom from vibration.

Shaft: — Ample diameter to safely transmit required power without undue bending and twisting.

Shaft sleeves, case rings, bearings, stuffing boxes, packing glands and all other features of design and construction are all completely in line with Warren's policy of "No Compromise on Quality". Write for further information or bulletins regarding these Warren Centrifugal Pumps.



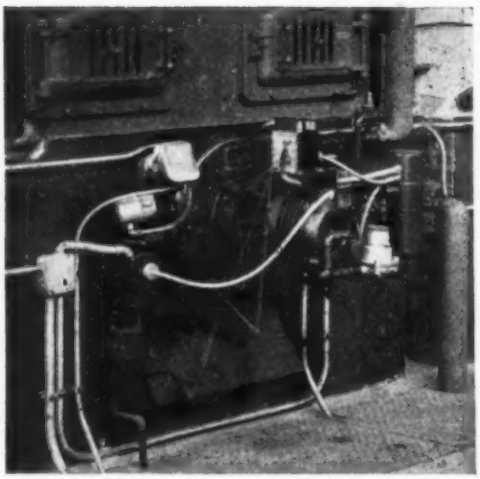
A Warren employee talks with an admiral about the Warren "E" Award. *All* Warren employees take great pride in the Warren Tradition for reliable, economical performance in peace times . . . and Warren's "service to the end" Tradition in war times.

WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS

EXPLOSION PROTECTION

For
- Gas
- Oil
- Powdered Coal
- or for any combination of these fuels



A typical combination gas and oil burner —Flame-o-trol installation. (Complete purging cycle, safety shut-off features and pilot light of sufficient size to insure main flame stability).

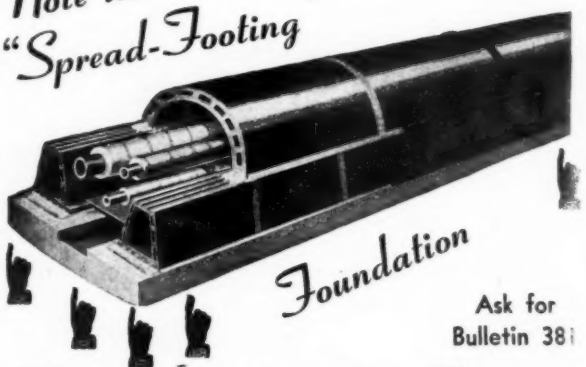
Wheelco FLAME-OTROL

—is a Wheelco pioneered electronic achievement, which provides dependable protection against explosion hazards by instantly shutting off the fuel to the burner in case of flame failure, disturbance in the electrical system, or should any condition develop within the instrument itself which might interfere with its operation. Fuel and explosive products accumulation, the source of explosion hazard, is eliminated. Available with automatic or manual ignition, time delay for purging, or other desirable sequences.

Request Bulletin L2

Wheelco Instruments Co.
863 West Harrison St. Chicago, 7, Ill.
"Electronic Principle" Temperature Controls

Note the "Spread-Footing"



Foundation

Ask for Bulletin 381

THERM-O-TILE

Reg. U. S. Pat. Off.

This concrete "Spread-Footing" Foundation maintains permanently the grade of the underground piping. Crushed stone eliminated. Powerful arched construction.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See our space in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.
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Without obligating us in any way, ☐ Please send Bulletin 381. ☐ Send representative. ☐ Enclosed is a sketch, with principal data of a prospective underground piping job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Clip your name, firm, and address to this ad; tear out with the checked squares above; mail; and you will hear from us promptly.

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1. BUY WAR BONDS.
2. Make equipment last.
3. BUY WAR BONDS.
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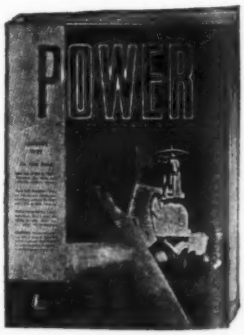
5. Save at least 10% of every paycheck in bonds.
6. Read every issue of POWER to help you build plant economy.



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HEAT EXCHANGERS, CONDENSERS and VACUUM EQUIPMENT

FOR EVERY POWER PLANT NEED

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★ Steam Jet Air Pumps
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★ Boiler Blowdown Heat Exchangers
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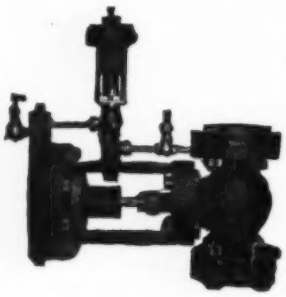
Squires CLASS E PUMP GOVERNOR

Is simple in construction and fulfils all conditions required of a pump governor. Real service is expected from every cash outlay for mechanical equipment, and Squires Steam Specialties are a receipt in full for such investments. It's worth your while to inquire about them.



Squires
Class E
Pump
Governor

Described in Catalogue A-11. Sent upon request

The C. E. Squires Company

East 40th St. and Kelley Ave., Cleveland, Ohio

MAKE THE NAME — "Industrial" YOUR STANDARD for

CUT GEARS
CUT RACKS
CUT SPROCKETS

We have the facilities, the equipment, the personnel and the "know-how" to give you the kind of service and cooperation you need for cut gears of any type, in any quantity—any material.

We also produce sprockets for Roller and Silent Chains and do precision surface grinding. Latest modern equipment.

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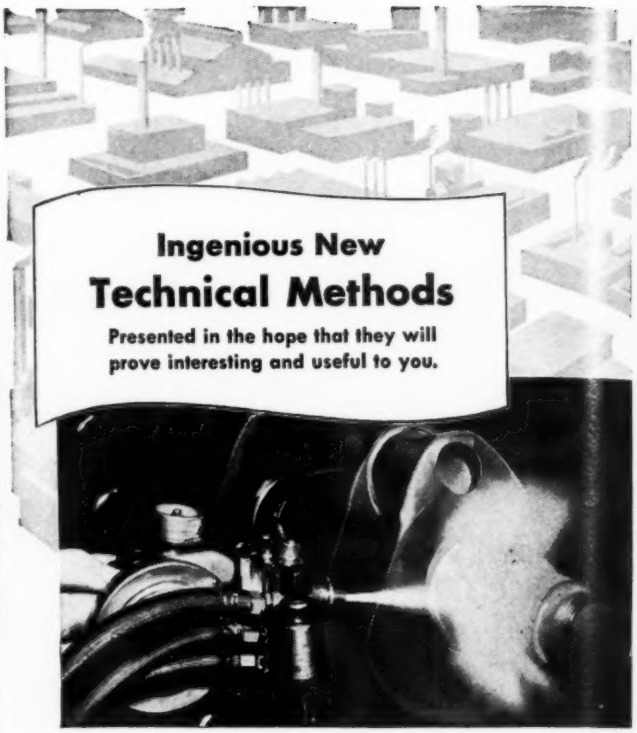
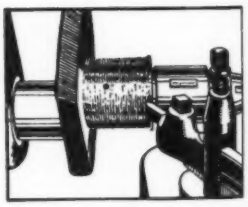


Ingenious New Technical Methods

Presented in the hope that they will prove interesting and useful to you.

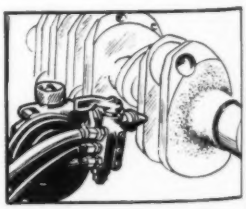
New Metal Surfaces Made by Spraying

Molten metal is now sprayed or atomized on to metal surfaces for the purpose of salvaging worn bearings, shafts, cylinder walls and such parts. Metallizing, as the process is called, is also used for putting a non-corrosive coating on iron or steel surfaces subject to corrosion such as cylinder walls of internal combustion engines, valve gates and such parts in contact with water. The metals to be sprayed may be aluminum, zinc, stainless steel, high carbon steel or other alloys depending upon the character of the surface desired. The sprayed surface may be "over built" and machined down to size to obtain accurate surfaces.



Rough threading—cooling locks metal firmly to surface, producing a permanently tight bond.

Metal spraying guns have been perfected for use with various types of gases for heat, depending upon the melting temperature of the metal to be sprayed.



Sprayed journal before finishing—Main bearing journal after surface has been Metallized.

We hope this has proved interesting and useful to you, just as Wrigley's Spearmint Gum is proving useful to millions of people working everywhere for Victory.

You can get complete information from the Metallizing Company of America, 1330 W. Congress St., Chicago, Illinois.

Y-102

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Turning out a hollow forging like this—involving a flanged, curved, and upset section—is a tough undertaking. And yet it is typical of the kind of jobs that many people feel we are better qualified to handle than any other forging plant.

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No other fittings for pipe welding combine these features found in WeldELLS:

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Take over the active direction of this drive to meet —*and break*—your plant's quota. And see to it that every one of your associates, from plant superintendent to foreman, goes all-out for Victory!

To meet your plant's quota means that you'll have to hold your present Pay-Roll Deduction Plan payments at their all-time high—plus such additional amounts as your local War Finance Committee has assigned to you. In most cases this will mean the sale of *at least* one $100 bond per worker. It means having a fast-cracking sales organization, geared to reach personally and effectively every individual in your plant. And it means hammering right along until you've reached a 100% record in those *extra* $100 —or better—bonds!

And while you're at it, now's a good time to check those special cases—*growing more numerous every day*—where increased *family* incomes make possible, *and imperative,* far greater than usual investment through your plant's Pay-Roll Deduction Plan. Indeed, so common are the cases of two, three, or even more, wage-earners in a single family, that you'll do well to forget having ever heard of '10%' as a reasonable investment. Why, for thousands of these 'multiple-income' families 10% or 15% represents but a paltry fraction of an investment which should be running at 25%, 50%, or more!

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LET'S ALL BACK THE ATTACK!

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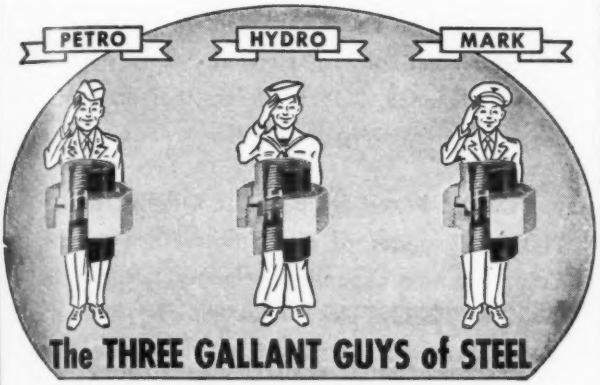

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- THAT IF THERE IS A "STIFF" CONNECTION, THE STRESSES SET UP WILL BE TREMENDOUS?
- THAT YOU MUST PROVIDE FOR THE EXPANSION?

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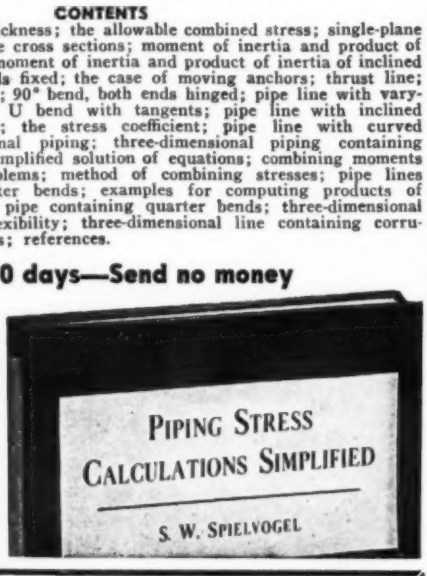

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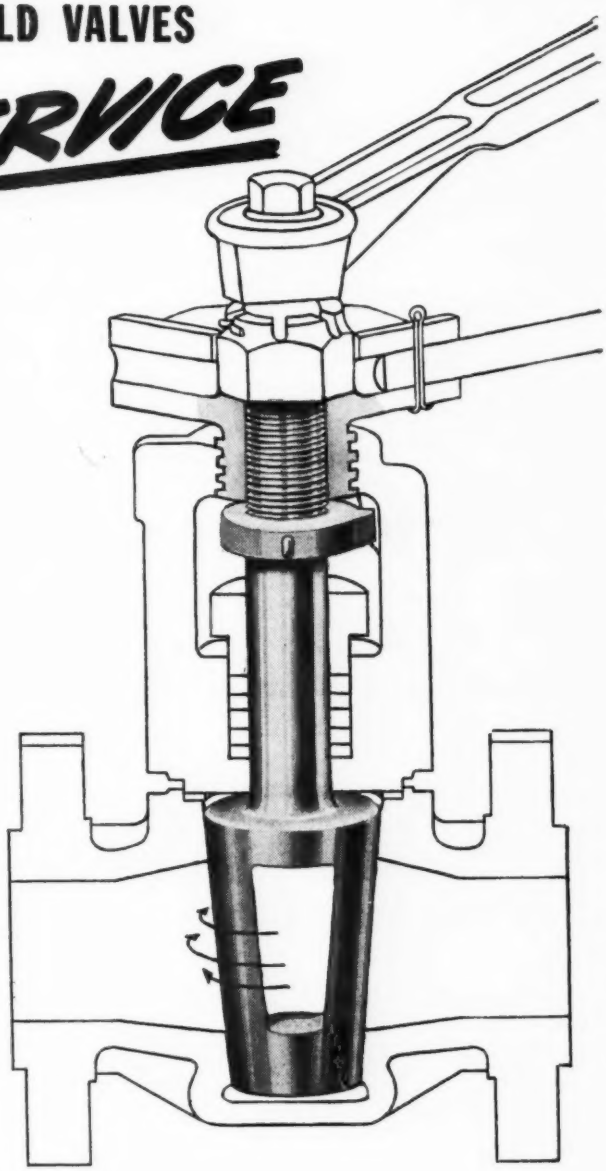

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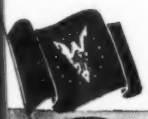

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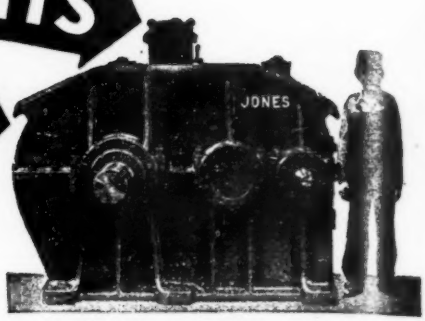

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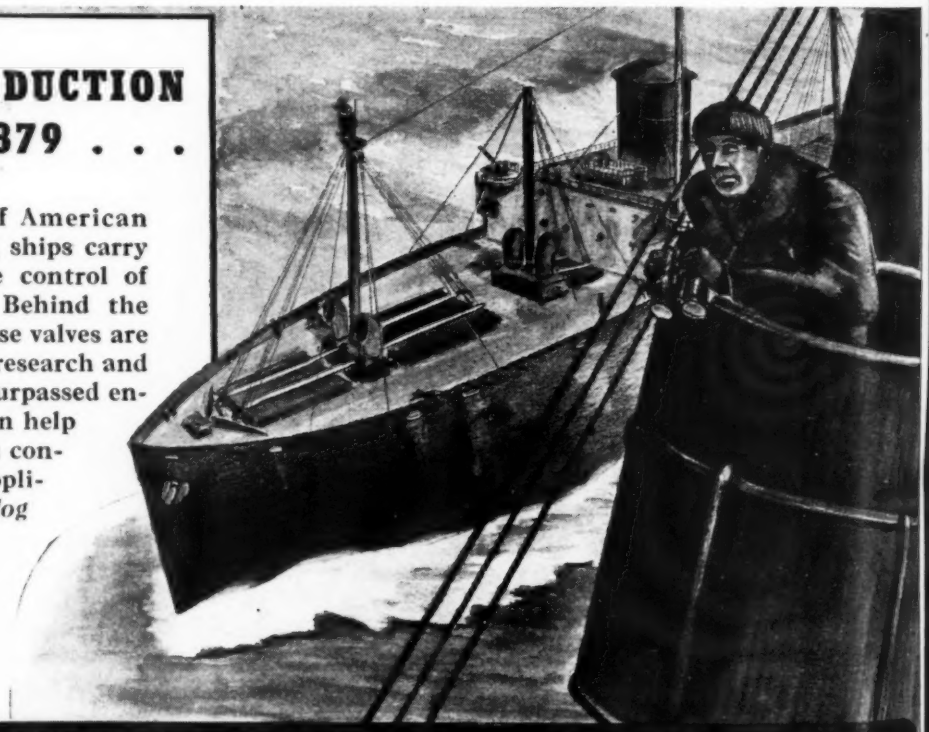

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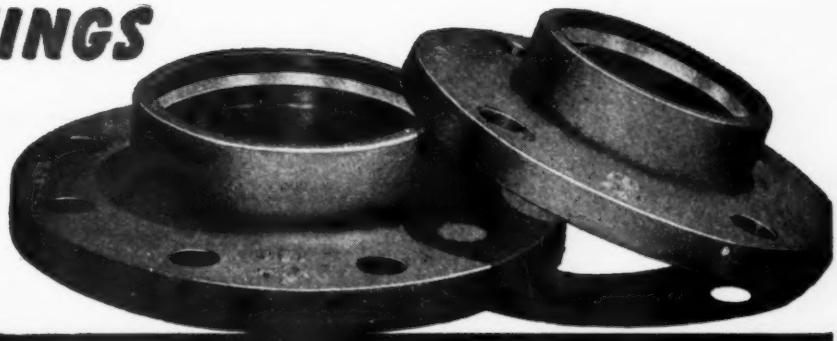
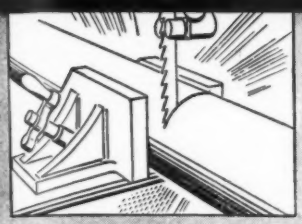
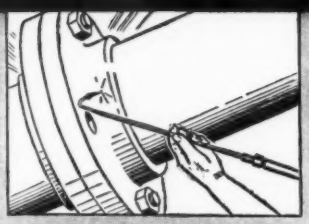


...THE MODERN METHOD OF JOINING COPPER OR BRASS PIPE AND TUBING

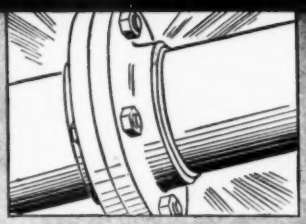


Cut pipe or tubing square, making certain that the pipe is not squeezed out of round or made undersize.

After cleaning flange and pipe carefully, apply flux to the flange recess and to the pipe or tubing.



Expand pipe by heating with the oxyacetylene flame. Next heat section of flange hub; then heat both pipe and flange hub section with wiping motion of torch.



Repeat process on adjacent flange hub and pipe sections. The joint is completed when a fillet of silver brazing alloy shows entirely around pipe at edge of hub.

You can save installation time and assure strong, permanent assemblies by using Walseal flanges, fittings and valves. As illustrated in the sketches above, four simple steps connect a flange to the pipe with a silver brazed joint that is tight, leak-proof, and has a corrosion resistance equal to that of the pipe or tubing itself.

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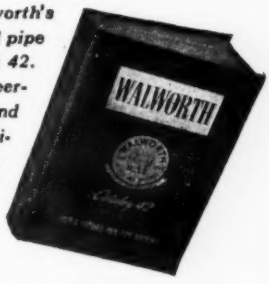

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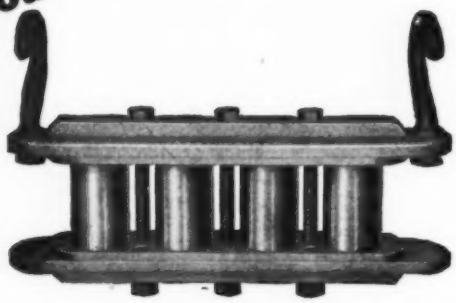

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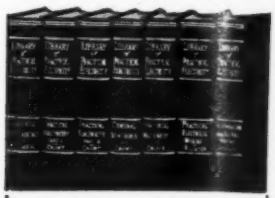

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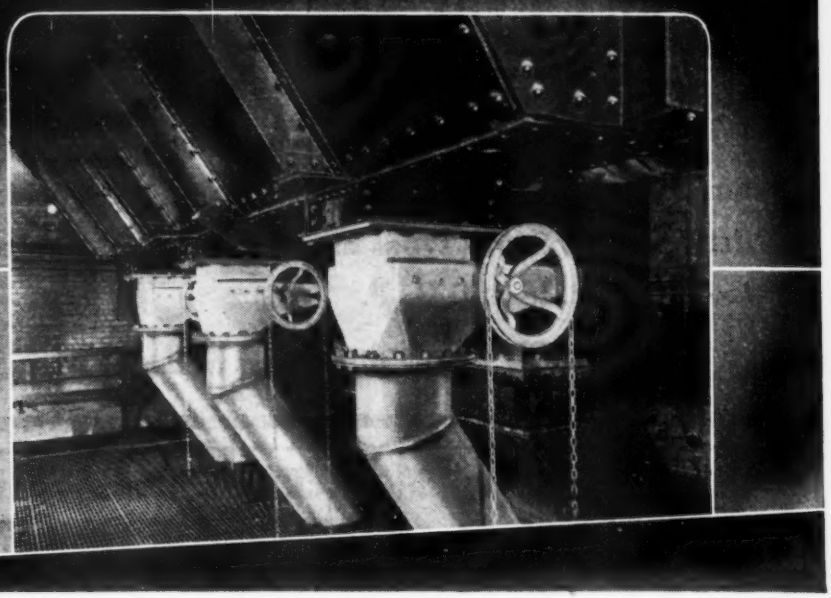
Company ..... P. 2-44

Do you want a Coal Valve that works?



What good is a coal valve if it sticks and refuses to function? Coal valves are often left in the open or closed position for many days . . . sometimes weeks and months. Moisture and sulfur cause deterioration of valve parts to a point where operation of the valve is difficult . . . sometimes impossible. The unique design of S. E. Co. Coal Valves is such that the valves always operate easily at all times, whether they are in constant use or merely stand-by use. If you want a coal valve that *works*, ask S. E. Co. Write today . . . address inquiries to Stock Engineering Company, 9807 Theodore Avenue, Cleveland, Ohio.

STOCK

★ ENGINEERING CO. ★

CONICAL Non-Segregating Coal Distributors — **S.E.Co. Coal Valves and Coal Scales**

THE TOLEDO SIMPACT 1" TO 2" RATCHET THREADER

—certainly fills the bill. Self-contained. No loose parts. One set of high speed steel dies threads all four sizes of pipe. Sizes changed rapidly. Work holder is simple and designed for long service. Ample length handle.

Specify a "TOLEDO" Simpact at your Dealers next time.

THE TOLEDO PIPE THREADING MACHINE CO.

TOLEDO, OHIO — **"TOLEDO"** TRADE-MARK REGISTERED U.S. PAT. OFFICE — **NEW YORK OFFICE, NO. 2 RECTOR ST.**

BUY WAR BONDS — **BUY WAR STAMPS**

BROWNELL BOILERS

For 88 years this company has been making good boilers. We invite comparison on quality, price, and delivery of various types and sizes of fire tube boilers from 3 H. P. to 250 H. P.

Write us for illustrated bulletins.

THE BROWNELL COMPANY — The World Over — DAYTON, OHIO, U.S.A.

MANZEL CHEMICAL FEEDERS—FOR ACCURATE, AUTOMATIC FEED WATER TREATMENT

When you inject boiler compound with a Manzel Chemical Feeder you KNOW your feed water is treated uniformly day after day. Installed directly on the boiler feed pump, the Manzel Feeder injects the chemical in accurately measured amounts exactly in proportion to the amount of water entering the boiler.

Manzel Chemical Feeders are sturdy dependable, self-contained units. Driven by the feed water pump, they start, stop, speed up and slow down with it. Thus, every gallon of water receives the correct amount of chemical. Feed is easily adjusted and very accurate. Once the feeder is set, it requires no attention except to keep the chemical tank supplied.

Write for bulletin

MANZEL BROTHERS COMPANY — **326 Babcock St., Buffalo 10, N. Y.**

WHERE TO BUY

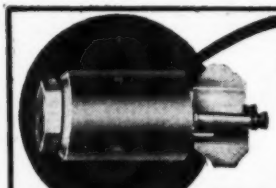
Featuring additional products and specialties for power plants

CHIMNEYS

Industrial Waste Burners

AMERICAN CHIMNEY CORP.
141 Fourth Ave.
New York City

BRANCHES: BOSTON
PHILADELPHIA · BUFFALO
CLEVELAND · DETROIT



STEP UP POWER NOW WITH A MOHAWK POWER SCRAPER

● Best way to remove soot, slag from boiler tubes. Baked slag quickly scraped and blown out by the Mohawk! Actually burnishes tubes—cannot possibly harm them. Uses steam or air. For all size fire tubes. Also inquire about Vibratap Tube Cleaners for removing scale from fire and water tubes.

BRUNT EQUIPMENT CO.
60 S. DIVISION ST. BUFFALO, N. Y.

THE ORIGINAL
Tripp Metallic Packing
TRIPP METALLIC PACKING CO.
BOSTON — MASS.

POWERS TEMPERATURE and HUMIDITY CONTROL

Automatic Control

For Industrial Processes, Heating and Air Conditioning Systems, Hot Water Heaters and Shower Baths. Write for Bulletins.

Offices in 47 Cities
2671 Greenview Ave., Chicago, Ill.

THE POWERS REGULATOR CO.

End Pump Troubles!

HILL IMPROVED PUMP VALVES

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

Send today for bulletin that tells how to get better pump performance.

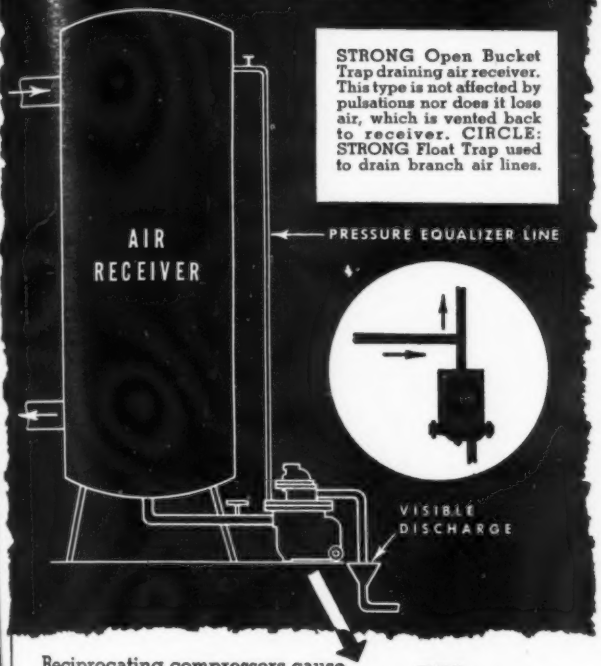
HILL PUMP VALVE CO.
2728 ELSTON AVE. — CHICAGO, ILL.

"MONO"
BOILER BAFFLES
HIGH TEMPERATURE
Refractory Cements
SANFORD C. SMITH REFRACTORIES, INC.
1715 NIAGARA ST., BUFFALO, N. Y.

A Good Habit

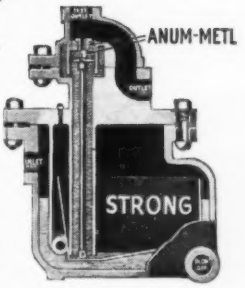
This Where To Buy Section supplements other advertising in this issue with additional announcements of products and materials of special interest and application in the power generation and transmission field. Make a habit of checking this page each issue.

DRAIN RECEIVERS WITH NO AIR LOSS



STRONG Open Bucket Trap draining air receiver. This type is not affected by pulsations nor does it lose air, which is vented back to receiver. CIRCLE: STRONG Float Trap used to drain branch air lines.

Reciprocating compressors cause pressure surges in air receivers. These pulsations tend to "bounce" buckets of inverted bucket traps, resulting in excessive wear of parts, continual discharge and loss of air.



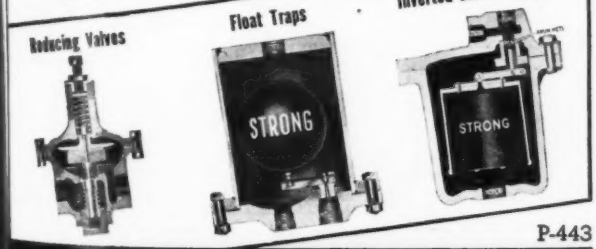
STRONG Open Bucket Traps are not affected by such pulsations. Only the weight of condensate in the bucket causes them to discharge. No air is lost during discharge, and air displaced from the trap by incoming condensate is vented back to the receiver.

This hook-up also is used for draining gas receivers and accumulators. Where liquids other than water are handled, special traps are furnished.

• • •

Completeness of the STRONG lines enable us to recommend exactly the type and size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc.—forged, fabricated (welded), cast and semi-steel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland, Ohio.

OTHER STRONG STEAM SPECIALTIES



P-443

STRONG
STEAM SPECIALTIES

Do You Know What "AUXILIARY OPERATED" means?

Angle, Fig. 214.
Globe, Fig. 214a.

This ATLAS Float Valve is "AUXILIARY OPERATED"

For that reason the ATLAS is superior in every way to ordinary float valves. The float shown here merely "Pushes a Button" and then SUPPLY PRESSURE does the actual heavy work of valve manipulation. Guaranteed to be positively drop tight.

The auxiliary valve does not have to move more than ¼ in. to open fully or close the main valve. Result: Extremely sensitive and accurate operation. Can be installed within the tank or in the supply line outside the tank and operated by a float in the tank. Strong and durable. Sizes ½" to 10". Globe or angle. Screwed or flanged. Complete data on request.

We make regulating valves for every service. See list of leading products below.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
289 South Street Newark, N. J.
Representatives in Principal Cities

Please send information on the following Atlas Products without obligating me in any way:

☐ Float Valves
☐ Campbell Boiler Feed Water Regulators
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control Systems
☐ Damper Regulators
☐ Pump Governors
☐ Oil Control Cocks
☐ Pressure Regulators
☐ Thermostats
☐ Balanced Valves
☐ Control Valves
☐ Humidity Controllers

Clip your name, firm, and address to this ad; tear out with the checked squares above, mail, and you will hear from us promptly.

By Using WEDGE Split CHILL RINGS

WELDED Joints will take FAR MORE SHOCK and VIBRATION

Split Feature Patented

A pipe line is no stronger than its WEAKEST point. Joints were the weak points, but by using WEDGE Chill Rings with the patented SPLIT Feature the picture is REVERSED. The reinforced joints are the STRONGEST points — under shock, strain or vibration the pipe will fail before the reinforced joints. Thousands of WEDGE Chill Rings are used in the Power field because they have proved successful.

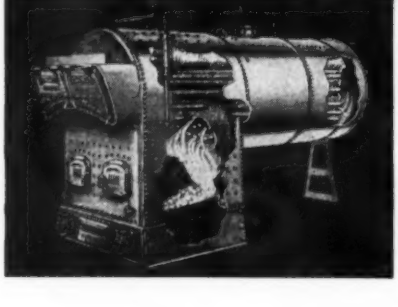
Write for circular and prices

WEDGE PROTECTORS, INC.
9524 Richmond Ave. Cleveland 5, Ohio

WEDGE CHILL RINGS SAVE MONEY

KEWANEE FIRE BOX BOILERS

Extra Strength . . . for Heavy Duty



Steel plus rivets supplemented by extra stout stays and braces in the boiler shell add extra years of service.

For 6" scale with pipe diameter markings, write Dept. 96-K2

KEWANEE BOILER CORPORATION Kewanee, Illinois

Division of AMERICAN Radiator and "Standard" Sanitary Corporation

ELECTRONICS in The Power Field

Watch for 24-page special section on this vital wartime and post-war subject in April POWER

PROFESSIONAL SERVICES

Consulting — Appraising — Planning

Construction — Designing — Testing

And Other Power-Field Services

THE BIRD-ARCHER CO.
Engineers and Consultants on Water Conditioning Problems
Surveys . . . Plant Studies . . . Analyses
400 Madison Ave. New York, N. Y.

COLUMBIA ENGINEERING CORP.
STRUCTURAL MECHANICAL & ELECTRICAL ENGINEERS
War Plant Design - Supervision of Construction - Engineering Reports
61 Broadway, New York, N. Y. — 323 Plum Street, Cincinnati, Ohio

H. E. CORL
CONSULTING ENGINEER
Design Supervision of Construction Management
Industrial and Municipal Power Plants
Steam and Diesel
Steam and Electric Power Distribution Systems
Plants Surveys — Appraisals — Reports
1316 Arch Street, Philadelphia, Pa.

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
Power Plant Design and Construction
Rehabilitation and Maintenance
Steam — Diesel — Hydro
Reports—Examinations—Laboratory
Industrials and Utilities
61 Broadway, New York — Reading, Pa. — National Press Bldg., Washington, D. C.

HALL LABORATORIES, Inc.
R. E. HALL, Ph.D, Director
CONSULTANTS ON BOILER WATER CONDITIONING
304 Ross St. Pittsburgh, Pa.

An Aide to the Business Executive

The power consultant renders an invaluable type of service because he can devote himself exclusively and wholeheartedly to an assigned problem and is free from the routine demands of active management with which the business executive is daily confronted.

In essence, the consultant is a special aide to the busy administrator in augmenting and building a work-program of increased efficiency.

PUBLIC UTILITY ENGINEERING & SERVICE CORPORATION
CONSULTING ENGINEERS
Design — Operations
Steam - Hydraulic - Gas
231 S. La Salle St., Chicago (4), Ill.

SANDERSON & PORTER
Engineers
for the
FINANCING—REORGANIZATION—DESIGN—CONSTRUCTION—
of
INDUSTRIAL and PUBLIC UTILITIES
Chicago — New York — San Francisco

SARGENT & LUNDY
ENGINEERS
140 South Dearborn St.
CHICAGO, ILLINOIS

J. E. SIRRINE & COMPANY
Power Plants — *Engineers* — Consultation
Design — Reports
Water — Steam Utilization — Plans
Greenville, South Carolina

STANLEY ENGINEERING COMPANY
CONSULTING ENGINEERS
Power Plants
Steam - Diesel - Hydro
Design - Construction - Test - Valuation
Central State Bank Bldg., Muscatine, Ia.

JOHN A. STEVENS, Inc.
Established 1900
CONSULTING ENGINEERS
Power Plants — Paper Mills
Dye Houses — Surveys
Lowell, Massachusetts

STONE & WEBSTER ENGINEERING CORPORATION
Design and Construction
Reports • Examination • Appraisals
Consulting Engineering
BOSTON • NEW YORK • CHICAGO • HOUSTON
PITTSBURGH • SAN FRANCISCO • LOS ANGELES

THE J. G. WHITE ENGINEERING CORPORATION
ENGINEERS—CONSTRUCTORS
New York, N. Y.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

10 cents a word, minimum charge $2.00.

(See ¶ on Box Numbers.)

POSITIONS WANTED (full or part-time individual salaried employment only), ½ the above rates.

PROPOSALS, 50 cents a line an insertion.

INFORMATION:

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

The advertising rate is $6.30 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

NEW ADVERTISEMENTS received by February 10th will appear in the March issue, subject to limitations of space available.

POSITION VACANT

BOILER INSPECTION

Wanted: by leading boiler insurance company man who after necessary training can qualify as boiler inspector. Technical background desirable. Practical experience in operation, maintenance or construction of high pressure boilers necessary. This position rated essential by War Manpower Commission.

P-628, Power
330 West 42nd St., New York 18, N. Y.

POSITIONS VACANT

ERECTION ENGINEER wanted with practical experience in power plant construction work. Nationally known manufacturer has profitable job open for a man capable of taking charge of erection work. The position will entail some traveling, but no selling. We want an engineer first, and will be glad to train the successful applicant. Liberal salary commensurate with man's ability, and full opportunity to develop larger earnings. In writing give full details. P-642, Power, 16 South Broad St., Philadelphia 2, Pennsylvania.

FIRE PROTECTION ENGINEER and Inspector. Permanent positions open in East, South, or Middle West, with large industrial fire insurance organization. Previous knowledge in this work not necessary. Applicant must be a technical graduate with manufacturing or engineering experience, and possess a good personality. Send photo with letter. Applications from demobilized servicemen with the above qualifications will be welcomed. Men subject to draft for military service cannot be considered. P-644, Power, 330 W. 42nd St., New York 18. N. Y.

(See also page 315)

EMPLOYMENT SERVICE

SALARIED POSITIONS — This advertising service of 34 years recognized standing negotiates for high salaried supervisory, technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 279 Delward Bldg., Buffalo, N. Y.

POSITIONS WANTED

STEAM POWER PLANT ENGINEER, sober and dependable with my 22 years experience and some Technical Training and capable taking charge of operating maintenance. PW-634, Power, 520 N. Michigan Ave., Chicago 11. Ill.

GRADUATE MECHANICAL ENGINEER, 32, married. Outstanding record over 10 years in boiler and turbine testing, operation and maintenance. Familiar fuel, oil and water chemistry, training plant operators and mechanical plant design. Desires connection with utility, industry or equipment manufacturer. PW-643, Power, 520 N. Michigan Ave., Chicago 11. Ill.

STEAM POWER ENGINEER, age 38, 16 years experience in steam electric plant operation and maintenance, technical school training, experience in supervision. Seeking employment in idustrial or utility steam plant. PW-651, Power, 520 N. Michigan Ave., Chicago 11. Ill.

MECHANICAL ENGINEER, 34, Recent college organization and management training. Broad experience relative to good engineering practice. Can assume responsibility. PW-652, Power, 330 W. 42nd St., New York 18, N. Y.

REPRESENTATIVES WANTED

ENGINEERING SALESMAN—calling on power organization and management training. established and expanding Middle West manufacturer of industrial chemical water treatments, roof coating, flooring, water proofing, and maintenance materials. New and nationally known products. Give age, experience, and compensation expected. RW-640, Power, 520 N. Michigan Ave., Chicago 11. Ill.

ELECTRIC MOTOR ENGINEER and Salesman for post war selling of new and used electric motors and switchboard equipment. Good base pay and percentage of sales. Position open now. SW-641, Power, 330 W. 42nd St., New York 18, N. Y.

DRAFTSMEN WANTED
for Centrifugal Pump Work

Permanent Positions. Excellent working conditions. Experience in pump work preferred but all applicants will be considered.

WARREN STEAM PUMP CO., INC.
WARREN, MASS.

WANTED

CHIEF ENGINEER

with designing and shop experience, particularly pulp, paper and associated fields. Write giving references, salary desired, draft status, etc.

P-645, Power
330 W. 42nd St., New York 18, N. Y.

AGENTS WANTED

to sell the reliable, sure-selling A-Jacks Complete Combustion Controls for high pressure boilers. New improvements make these controls even easier to sell than before. Territories still open in various parts of the country. Write to A-Jacks Automatic Regulator Co., 14 So. Clinton St., Chicago, Illinois, for complete information.

WANTED

MANUFACTURER'S AGENTS

by a well-known manufacturer of a spreader stoker on which you can make some real money. This is a sure-selling proposition for hospitals, office bldgs., industrial plants, etc. Write in confidence as our entire sales organization knows of this ad.

RW-648, Power
520 N. Michigan Ave., Chicago 11, Ill.

WANTED

A Product to Manufacture

Organization of several hundred skilled designers, engineers, and toolmakers, and a modern tool room seeks post war product or machine to tool. Complete facilities for development from tooling to sales and advertising.

BO-639, Power
330 W. 42nd St., New York 18, N. Y.

MOTOR REWINDS?
ARE YOU PARTICULAR?

DO YOU HAVE A SPECIAL MOTOR?

We stock the Best of Insulation

100% Factory Work
TRY US

Previous Experience with
General Electric **Allis Chalmers**
Westinghouse **Navy Yard Work**

C. V. HUNT
Est. 1916
Ridgefield, N. J. **Morsemere 6-5091**
Trucks #1—U.S. Highway and Erie Railroad

WANTED
MECHANICAL OR CHEMICAL ENGINEERS

Major oil company with nation-wide operations seeks *Mechanical or Chemical Engineers,* preferably college graduates, with experience in lubricating oils and their application to industry. Sales experience in this field will be helpful but not essential.

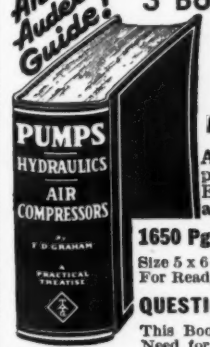
Such men can expect:

1. **A good future in work covering lubrication problems in industrial plants now primarily working on war equipment.**
2. **To participate in a training course presented by the employer.**
3. **To receive a good starting salary.**
4. **To have employment which will not be of a temporary nature.**

In reply state experience, education, age, marital status, draft classification and salary expected and include small snapshot (not returnable). Replies strictly confidential. If employed in essential war work, availability certificate required. If already working at your highest skill, do not apply.

P-637, Power
330 West 42nd St., New York 18, N. Y.

PUMPS



3 Books in One!

Now Ready—

AUDELS PUMPS
HYDRAULICS
AIR COMPRESSORS

A New Modern Comprehensive Guide for Engineers, Pump Operators and Mechanics.

1650 Pgs., 1654 Illustrations

Size 5 x 6¾ x 1⅜—Fully Indexed For Ready Reference including

QUESTIONS AND ANSWERS

This Book Covers a Long Felt Need for One Inclusive Volume dealing with the whole field of modern Pumps, Hydraulics, Air Compressors and the many lines that tie in. Easy to understand.

To get this assistance for yourself, simply fill in and mail *FREE COUPON* today.

$4 COMPLETE
PAY ONLY $1 A MO.

AUDEL, Publishers, 49 W. 23 St., New York 10
MAIL AUDELS PUMPS, HYDRAULICS, AIR COMPRESSORS (Price $4) on 7 days free trial. If O.K., I will remit $1 in 7 days and $1 monthly until the $4 is paid. Otherwise I will return it.

Name_____

Address_____

Occupation_____ PWR

ELECTRICAL POWER EQUIPMENT

TURBO GENERATORS

3 Phase, 60 Cycle

6000 KVA WESTINGHOUSE 250-400 lbs. 2300 volts, with surface condenser.

2500 KVA WESTINGHOUSE non-condensing, 250-400 lbs., 2300 volts.

1875 KVA GENERAL ELECTRIC 150-200 lbs. 2300 volts with surface condenser.

SURFACE CONDENSER

1540 sq. ft. WORTHINGTON surface condenser with steam jet air pumps.

MOTOR GENERATORS

3 Phase, 60 Cycle

1500 KW GENERAL ELECTRIC synchronous 275 volts D.C., 2200/4400 volts A. C., 360 RPM.

1000 KW GENERAL ELECTRIC 3-UNIT synchronous 125/250 volts D.C., 4000/2300 volts A.C., 720 RPM.

500 KW GENERAL ELECTRIC synchronous 700 volts D.C., 4150 volts A.C., 720 RPM (Full Automatic).

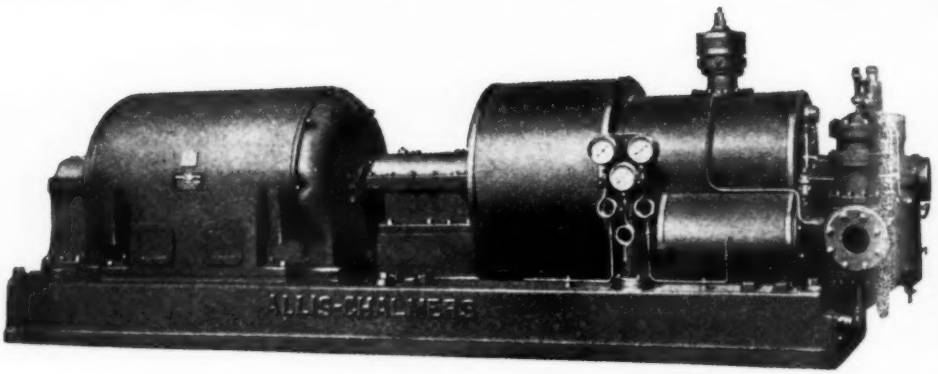
ENGINE GENERATORS

3 Phase, 60 Cycle

438 KVA GENERAL ELECTRIC-SKINNER uniflow, 150 lbs. 5 lbs. back pressure, 240/480/2300 volts.

340 KVA WESTINGHOUSE SKINNER uniflow, 150 lbs., 5 lbs. back pressure, 240/480/2300 volts, 200 RPM.

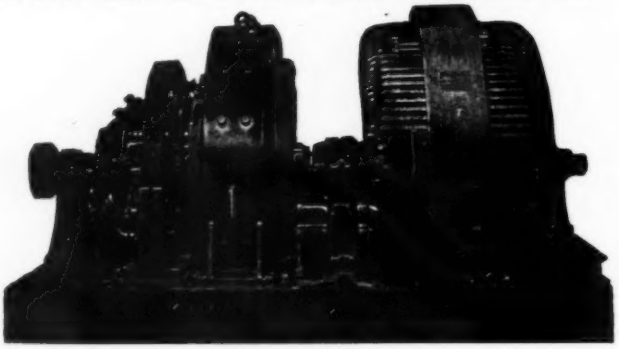
210 KVA GENERAL ELECTRIC engine type generator. 2300 volts, 225 RPM.



1250 KVA ALLIS CHALMERS CONDENSING TURBO UNIT

1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.

1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET



Actual Photograph

1000 KW GENERAL ELECTRIC direct current generator 125/250 volts 3-wire 720 RPM direct connected to 1400 HP 80% P.F. GENERAL ELECTRIC synchronous motor 3 phase 60 cycle 13200/6600 volts 720 RPM.

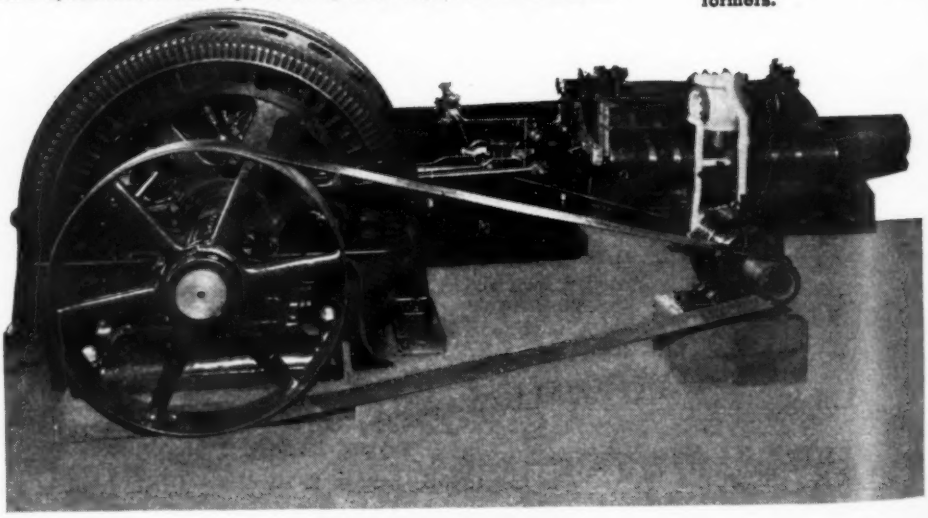
ROTARY CONVERTERS

3 Phase, 60 Cycle

3500 KW (2) WESTINGHOUSE 225-285 volts D.C., 225 RPM, with 13200 volt transformers.

2600 KW (2) GENERAL ELECTRIC booster, 250/300 volts D.C., 300 RPM, with 5040/210 volt transformers.

750 KW GENERAL ELECTRIC 600 volts D.C., 1200 RPM. with 2300/4000 volt transformers.

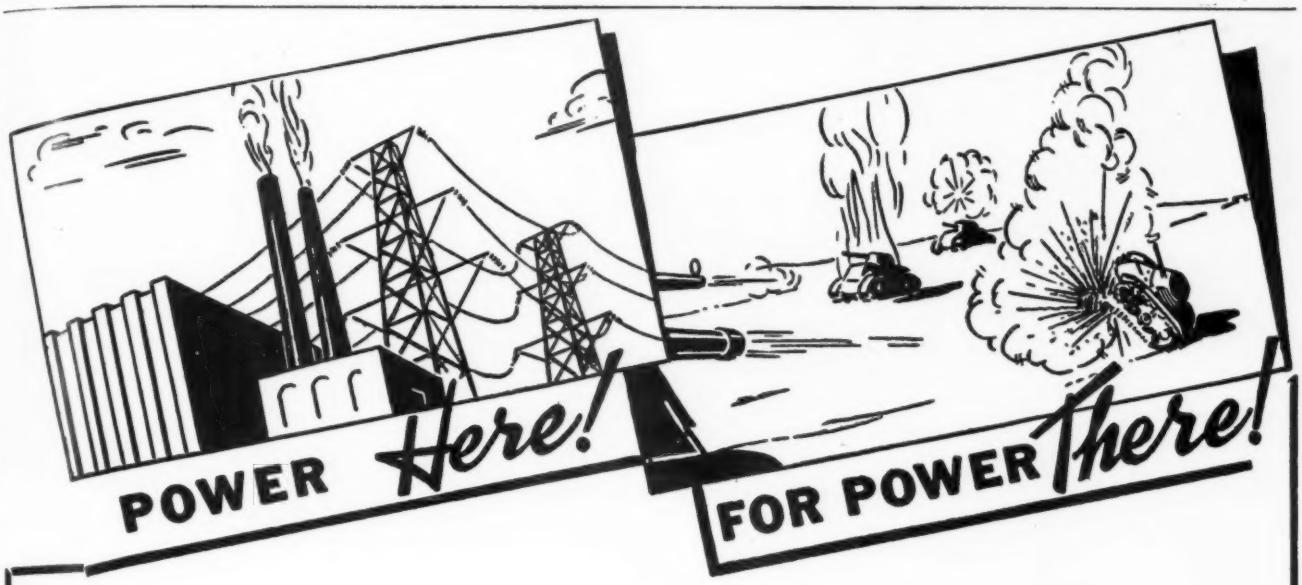


Actual Photograph

675 KVA SKINNER UNIFLOW UNIT

675 KVA Electric Machinery alternating current generator 3 phase 60 cycle 2300/600/480 volts direct connected to Skinner Universal uniflow engine, 150-175# steam pressure, 0-10# back pressure, 150 RPM.

THE NATIONAL POWER MACHINERY CO.
1921 SCRANTON ROAD CLEVELAND, OHIO



MOTORS GENERATOR SETS

1—2000 ampere, 6 volt, Hanson-Van Winkle
1—1500 ampere, 6 volt, Hanson-Van Winkle
1—750 KW, 250 volt, Allis Chalmers synchronous
1—75 KW, 125 volt, General Electric, squirrel cage.
1—20 KW, 600 volt, General Electric squirrel cage induction motor.
1—6½ KW, 125 volt, General Electric, squirrel cage

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chal.

MOTORS—3 PHASE 60 CYCLE

1—500 HP, 900 RPM Lincoln, 440 volt, slip ring
1—400 HP, 514 RPM, 440 volt, Westg., slip ring.
1—350 HP, 300 RPM, 440 volt General Electric slip ring
1—335 HP, 600 RPM, 2300 volt, G.E., syn.
1—300 HP, 720 RPM, 2200 volt, G.E., slip ring.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., Sync.
1—200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—150 HP, 1800 RPM, 440 volts, General Electric, squirrel cage.
1—150 HP, 1750 RPM Westinghouse, slip rg.
1—150 HP, 1200 RPM, General Electric, squirrel cage.
1—150 HP, 900 RPM., 440 volt, Al. Ch. sl. rg.
1—100 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—125 HP, 720 RPM Allis Chalmers, slip rg.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.

INSTRUMENTS

25—Westinghouse type U Recording Ammeters with slit core, CT
25—Westinghouse type U Recording Volt-meters.

MOTORS—3 PHASE 60 CYCLE (Con't)

2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1—90 HP, 400 RPM, 550 volt, Cr. Whlr., sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1—75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
1—75 HP, 900 RPM, 440 volt, G.E., sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1—75 HP, 720 RPM, 440 volt, G.E., sq. cg.
2—75 HP, 1200 RPM, 2200 volt, G.E., Vertical.
1—50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL, Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—150 HP, Westghse., 550 RPM, Type SK.
1—150 HP, 750 RPM, Electro Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM, G.E., Type RC.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
1—50 HP, 750 RPM, Westghse., Type SK.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type LC.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 800 RPM, G.E.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—25 HP, G.E., 650 RPM, Type RC-15.
1—20 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
2—20 HP, Westghse., 1700 RPM, Type SK.
1—15 HP, G.E., 800 RPM, Type RC-11.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—200 KVA, G.E., 2200/220/440.
3—150 KVA, G.E., 33,000/ 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200-250 volts.
3—75 KVA, G.E., 13,500-750/440 volts.
3—75 KVA General Electric, 2200/220/110
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
3—50 KVA, G.E., 2200/220/110.
2—50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
3—37½ KVA, G.E., 2200/220/440.
2—30 KVA Allis Chalmers, 3 phase, 4156Y/120/208Y
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

1—150 HP, 350/1050 RPM, Crocker-Wheeler.
2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electro Dynamic.
1—30 HP, 225/900 RPM, Crocker Wheeler.
7—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

TURBO-GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v., cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 v., cond.

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J. L. HEMPHILL & COMPANY

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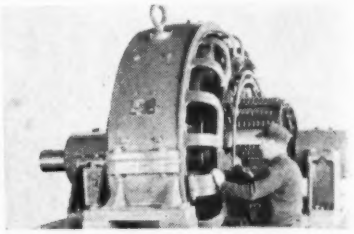

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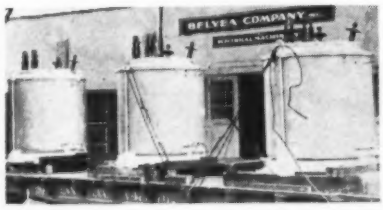

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1000 KW G.E., 600 V. D.C. to 1400 H.P. 4000 V.

1—1000 KW WHSE., 600 V. D.C. to 1400 H.P. 4000 V.

1—500 KW 3 unit consisting of 2—250 KW G.E., 250 V., d.c., to 1—700 H.P. 2300 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.

1—500 KW G.E., 250 V. D.C. to 1000 KVA, 2200 V. Syn. Motor.

1—400 KW G.E., 250/275 V., D.C. to 600 HP, 2300 V.

1—300 KW G.E., 250/275 V. D.C. to 400 KVA 440 V.

1—260 KW 3 unit consisting of 2—130 KW G.E., 75 V. D.C. to 600 KVA 220/440 V.

1—100 KW WHSE., 250 V. D.C. to 159 KVA, 2300 V.

1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg. 2300/4000 V.

2—50 KW G. E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

1—40 KW WHSE., 230 V. D.C. to 45 KVA 2300 V.

1—35 KW A. B. See 230 volt D.C. to 50 H.P. 220 volt sq. cg. motor with exciter.

TURBO GENERATOR SETS

1—500 KW Whse. 625 Kva. 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.

1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lb. pressure with 12 lb. bk. pres., 2000 RPM

A. C. GENERATORS AND SYNO. MOTORS

3 Phase—60 Cycle

HP or KVA	Make	Type	Volts	Speed
1—1000	Whse.		2300	900
1— 750	G.E.	ATI	220/440	900
1— 600	G.E.	ATI	220/440	900
1— 625	Whse.		480	900
1— 500	G.E.	TS	440	360
1— 250	G.E.	ATB	2300	600
1— 225	G.E.	ATB	220	600
1— 150	Whse.		2400	900
1— 150	Whse.		4000	1800
1— 100	Whse.		2400	900
2— 100	Whse.		2300	1800

A. C. MOTORS

3 Phase—60 Cycle

SLIP RING

HP	Make	Type	Volts	Speed
1—1200	Cr. Wh.	801Q	2300	237
1— 800	Al. Ch.	ANY	440	885
1— 800	Whse.	CW	440	357
2— 600	G.E.	IP	440/2200	720
1— 600	G.E.	IM	440	900
1— 450	Whse.	HW	2200	875
1— 400	Al. Ch.	ANY	440	1200
1— 400	G.E.	MT	550/440	300
1— 400	Al. Ch.	ANY	2300	505
1— 400	G.E.	IP	440/2200	600
1— 350	G.E.	MT-442	2300/4000	257
1— 300	G.E.	IM	440	720
1— 300	Whse.	CW	440	585
1— 250	G.E.	MT	4000/2300	257
1— 200	G.E.	IF-M	2200	1750
1— 200	Whse.	CW	2200	514
1— 200	G.E.	I-M	440	600
1— 150	G.E.	IM	2200	695
1— 150	G.E.	MT-564	440	600
1— 150	G.E.	IM-17B	2200	290
1— 100	G.E.	IM	220	1750

A. C. MOTORS

SQUIRREL CAGE

HP	Make	Type	Volts	Speed
1—500	G.E.	1-17B	2200	690
1—400	Whse.	CS-1104A	2200	585
1—300	Whse.	CS	550	580
1—300	G.E.	IK	440/2300	600
1—200	G.E.	IK	2300	490
4—175	G.E.	IK	440	900
1—150	Lincoln		440	1200
1—150	G.E.	IE	440	1200
1—150	Al. Ch.	AN	440	1765
1—100	Whse.	CS	550	1750

GEAR REDUCTION UNITS

1—2100 H. P. Whse. 1800/360 RPM.
1— 943 H.P. G.E. 5306/1200 RPM
1— 750 H.P. Al. Ch 3600/600 RPM
1— 450 H.P. G.E. 3600/1200 RPM

THE BELYEA REPUTATION PROTECTS YOU!

ROTARY CONVERTERS

3 Phase, 60 Cycle

Qu.	KW	Make	Speed	DC V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
3	300	G.E.	1200	600	2300

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500	225/275	13200/6600
1	500	G.E.	750	225/275	13200/6600

All units can be furnished with AC and DC controls

TRANSFORMERS

60 Cycle

KVA	Make	Ph.	Type	Voltages
6—1667	Pitts	1	OISC	13200x2300
4— 525	G.E.	1	HJ-DD	2300x445
3— 333	Maloney	1	OISC	22000/11000x2300/575
2— 333	Whse.	1	OISC	2300x460
2— 333	Pitts.	1	OISC	2400x220
3— 300	G.E.	1	H	13200x2300/575
2— 200	G.E.	1	HILD	26400x115/460
3— 200	G.E.	1	H-KDD	13800x220/440
3— 150	Whse.	1	SK	2200x440/220
3— 150	Whse.	1	SKM	2400x120/240
6— 100	Whse.	1	SK	6900x460/230
3— 100	Whse.	1	OISC	13200x250

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1250	G.E.	MCF	250	650
2—1250	G.E.	MPC	500	130
1— 800	G.E.	MPC	550	600
2— 625	G.E.	MPC	250	130
2— 600	G.E.	MPC	550	600/800
1— 500	G.E.	MPC	230	900
1— 400	G.E.	MPC	230	900
1— 350	G.E.	MPC	230	450
1— 300	G.E.	MCF	230	400/100
2— 300	G.E.	DMC	230	400/600
2— 300	Whse.		500	250/400
1— 300	G.E.	MPC	230	275/550
1— 300	G.E.	MPC	230	250/440
1— 250	Al. Ch.	Irt	230	525
2— 200	Whse.		230	400/500
1— 175	Whse.	SK	250	150/525
1— 150	G.E.	RC-19	230	800/1000
1— 150	Whse.	SK	230	300/900
2— 125	G.E.	CO-1832	230	625
2— 120	Whse.	SK	230	720
1— 100	Al. Ch.		230	950/1150
3— 100	G.E.	LC	230	1200
1— 100	G.E.	MPC	230	225/450
1— 100	Whse.	SK	230	600
2— 100	G.E.	RC-19	230	575/720
1— 75	G.E.	C	230	500/100
3— 70	Whse.	SK-183	230	560/780
4— 60	Diehl	K-11	230	500/1000
2— 60	Cr. Wh.	CMC-65H	230	500/1000
1— 50	Cr. Wh.	CMC-81H	230	300/900
1— 50	Cr. Wh.	CMC-80H	230	380/750
10— 50	G.E.	RF-16	230	400/1600

RE-NU-BILT BELYEA MOTORS

SUCCESSFUL OPERATION GUARANTEED

BELYEA COMPANY INC.

***Main Office & Shop:* 43 HOWELL ST., JERSEY CITY, N. J.**

KIEMLE OF TOLEDO, OHIO

MOTORS
GENERATORS
CONTROLS
TRANSFORMERS
MOTOR GENERATOR SETS
ETC.

BERGER OF ROCHESTER, N.Y.

Put all idle equipment to work. Send your list for prompt action.

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300, 1 phase 25 cycle.
1—200 KVA Maloney type H.E. 2400/120/240 volts, 1 phase 60 cycle.
1—200 KVA, G.E., type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—250 KVA Pittsburgh, 2300/115/230 volts, 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.

OTHER SIZES, VOLTAGES AND CYCLES AVAILABLE

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle 3 phase, 450 rpm with direct connected exciter.
200 KW Westh. Unity Power Factor, 3 PH. 60 cyc. 900 R.P.M. with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 RPM, revolving field, built-in exciter.
150 K.W. Elect. Mach. Revolving fields, 3 Ph. 25 cy. 440 volts 750 R.P.M.

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V, 600 RPM.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.
125 K.W. Crocker Wheeler, 250 Volts D.C. Comp. WD. Dir. Con. To G.E. 2300 or 440 Volts Sq. Cage Motor
100 K.W. Gen. Elect. 3 BRG. 125 Volts D.C. Comp. WD. INT. with 220/440 Volts Sq. Cg. Motor.
100 K.W. Gen. Elect. 3 BRG. 230 Volts D.C. Comp. WD. INT. with 2300 Volts Sq. Cg. Motor.

CRANE MOTORS

75 H.P.—G. E. 51—230 Volts—550 RPM
35 H.P.—G. E. Form D—550 Volts—590 RPM
25 H.P.—Form E—550 Volts—760 RPM

2-Ton Shephard Hoist With 3-H.P. Hoist Motor and 2-H.P. Trolley Motor 3 Phase. Can Be Used Remote Control.

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle, 750 speed, 220/330 volts. With Transformers for 2300 volts.

FREQUENCY CHANGERS

40 KW GE type I.T.T. frame 553 3 ph. 25/62, ½ cy. 220 volts primary 440 volts secondary, 750 RPM direct con. to 40 H.P. GE type KT543— 3 ph. 25 cy. 220 volt, 750 RPM.

OTHERS IN ALL SIZES VOLTAGES AND CYCLES

3 ph. 60 cy. A. C. MOTORS

H.P.	Make		Type	Speed	Volts
250	West	S.C.	C.S.	900	440
200	West	Syn.	.08 P. P.	900	220/440
		WITH DIRECT CON. EXCITER			
200	Wsghse.	Sl. Rg.	CW	600	220/440
200	Gen. Elec.	Sq. Cg.	1 Form K	514	220/440
175	Ideal	Sl. Rg.	AVA	1750	2200
150	Gen. Elec.	Sq. Cg.	I K	600	2300
150	Al Ch	Sq. Cg.		600	440
150	Burke	Sq. Cg.	3 BRG. 2 ph	900	220/440
125	Gen. Elec.	Sl. Rg.	MT. 553	1200	220
125	Gen. Elec.	Sq. Cg.	I K	720	220/440
25	Gen. Elec.	Sq. Cg.	I. K. Vert.	720	220

3 ph. 25 cy. MOTORS

H.P.	Make		Type	Speed	Volts
830	Elect. Mach.	Syn.	Dir. Con. Exc.	500	2300
350	Gen. Elec.	Sl. Rg. 3 Brg.	I	375	440
200	Lincoln	S. R.	I. X. W.	500	440
150	Burke	Syn.	Dir. Con. Exc.	500	440
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
100	Wagner	Sl. Rg.	BR	750	220/440
100	Gen. Elec.	Sl. Rg.	I Form M	750	220/400
100	Gen. Elec.	Sq. C.	I K	750	220/440
100	Wsghse.	Sq. C.	CS	500	220/440
75	Wsghse.	Sq. C.	CCL	500	220/440
75	Gen. Elec.	Sl. Rg.	I M	750	220/440
75	Wagner	Sq. C.	BM	750	2200
75	Gen. Elec.	Var.	BTA	375/750	440
50	Burke	Syn.	AC 133	750	220
		WITH DIRECT CON. EXCITER			

230V D. C. MOTORS

H.P.	Make	Type	Speed
150	West	SK180L Comp. Wd. Int.	1150
125	G.E.	CL	850
100	Northwestern	K30 Comp. Inter.	1750
85	Gen. Elec.	Vert. Comp. Wound	700
75	Crocker Wh.	CCM25JA	1700
67	Otis	Elevator Motor Comp. wd.	1200
60	Sprague	D—Comp. Wound	625
50	Gen. Elec.	C. L. 6 Shunt Wound	560
40	Fair. Morse	Ball BRG. Vert. Comp.	1740
32	Sturdevant	C Form P. Shunt Wound	190

Only partial listing

OVER 10,000 ITEMS IN STOCK FOR IMMEDIATE DELIVERY FROM EITHER ROCHESTER, N. Y. OR TOLEDO, OHIO REBUILT AND SOLD WITH A STANDARD NEW GUARANTEE.

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ROCHESTER NEW YORK

The Mark of Dependability

THE FRED W. KIEMLE CO.
33 N. SUPERIOR ST.
TOLEDO OHIO

Partial List Only!

230 VOLT DC MOTORS

H.P.	Make	Speed
300	G.E.	1100
150	West.	600
60	Roth	600
60	G.E.	480/1100 (2)
50	West.	550/1100
50	Cr.Wh.	700 (2)
50	G.E.	850
45	Diehl	850/1020
40	Cr. Wh.	915
35	West.	1150
35	G.E.	440/1800
25	Diehl	850/1020
25	G.E.	1150
25	G.E.	575
20	Cr. Wh.	1750
20	G.E.	1200
20	R & M	1160
20	G.E.	1150 (4)
20	West.	1150
20	G.E.	1150
20	G.E.	800 (2)
15	West.	1250
15	G.E.	1250
15	G.E.	1150 (3)
15	G.E.	1150 (3)
15	Cr. Wh.	900/1800
15	West.	850
10	West.	850 (2)
10	G.E.	825 (3)
10	G.E.	700
10	Al. Ch.	600/1800
10	West.	600/1200
10	G.E.	400/1600
10	West.	400/1200 (2)
9	Al. Ch.	1750
9	G.E.	450/1800
8½	Diehl	900
8½	West.	850
8½	West.	350/1400
8	G.E.	500/1500
7½	Sturt.	3600
7½	Peerl's	1700
7½	West.	1450
7½	West.	1150 (2)
7½	G.E.	1150
7½	West.	975
7½	Al. Ch.	850
7½	El. Dy.	550/1650
7½	Watson	525/1150
7½	G.E.	450/1800
7½	G.E.	400/1600
7½	West.	400/1600
7½	Al. Ch.	350/1050
7½	G.E.	300/1200
6	G.E.	400/1200
6	G.E.	850
6	G.E.	450/1800 (2)
5½	West.	500/1500 (2)
5	West.	850
5	G.E.	900 (2)
5½	G.E.	400/1600
5	West.	1800
5	G.E.	1700
5	G.E.	1150 (2)
5	West	1100
5	Al. Ch.	1150
5	Cont.	600/1800
5	West.	850
5	G.E.	850
5	Star	600/1200
5	El. Dy.	550/1650
5	G.E.	450/800
5	G.E.	600
5	G.E.	450/1350
5	West.	400/1200
5	El. Dy.	275/1100
4	G.E.	850/1150
3½	West.	850/1600
3	West.	1700 (5)
3	West.	1150 (6)
3	Roth	500/2000
3	G.E.	500/1500
2½	West.	480/1800

325-230 volt DC Mtrs. down to 1/20 H.P.

115 VOLT DC MOTORS

H.P.	Make	Speed
20	West.	200/900
15	West.	1100
15	Cr. Wh.	800
10	L. Allis	3500
10	G.E.	1150 (3)
10	West.	850
10	El. Dy.	425/1275
7½	G.E.	850 (2)
6	Burke	650
5	Cr. Wh.	1875
5	Col.	1500
5	West.	1100 (2)
5	Cr. Wh.	960

75 additional 110 volt Motors down to 1/6 H.P.

3 PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
200	G.E.	600
150	G.E.	580
147	West.	715
100	G.E.	1200
100	West.	720
100	G.E. (BTA)	375/750
75	West.	870
50	West.	1200
50	Al. Ch.	690
40	G.E.	900
35	Wagner	850
30	U. S.	3450 Vert.
30	West.	1750 Vert.
30	Al. Ch.	850
30	Al. Ch.	514
25	Wagner	1200
25	West.	1140
25	Diehl	865 (3)
25	G.E.	900
25	Wagner	720
20	G.E.	1750 (3)
20	G.E.	1200 (2)
20	Cr. Wh.	1200 (2)
20	Al. Ch.	900 (2)
20	Diehl	900 (3)
20	G.E.	720
20	West.	1720
15	Cr. Wh.	1700
15	G.E.	1200 (3)
15	Wagner	720
15	G.E.	600
10	G.E.	720 (5)
10	G.E.	3450
10	West.	1150

40 additional three phase Motors down to ¼ H.P.

TWO PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
75	Cr. Wh.	870
50	Line.	900
50	G.E.	900
40	G.E.	900
40	Al. Ch.	900
35	Al. Ch.	900
30	West.	1200
25	G.E.	1200
20	West.	1150
15	G.E.	1200
15	F & M	900
10	G.E.	1200
10	G.E.	900
7½	G.E.	900
7½	G.E. (BQS)	600/1350
5	G.E.	900
5	Al. Ch.	1200

40 additional two phase Motors down to ¼ H.P.

SINGLE PHASE MOTORS

H.P.	Make	Speed
20	Wagner	1160
20	Cent.	1165
7½	Cent.	3500

8 additional single phase Motors

SLIP RING MOTORS

H.P.	Make	Speed
500	Al. Ch.	1180
250	G.E.	600
200	West.	720
200	G.E.	495
150	Al. Ch.	720
125	West.	1200
125	Burke	600
75	Al. Ch.	575
75	West.	1200
60	West.	1200
60	West.	290
50	Ideal	1740
50	G.E.	900 (3)
40	Wagner	1200
40	F & M	900 (2)
40	West.	900
40	Lin.	720
30	G.E.	720
30	G.E.	1200
25	Al. Ch.	900
25	G.E.	600
20	G.E.	900
20	West.	600
15	G.E.	900

33 additional slip ring Motors down to 1 H.P.

40 H.P.
Reliance Variable Speed Motor Drive

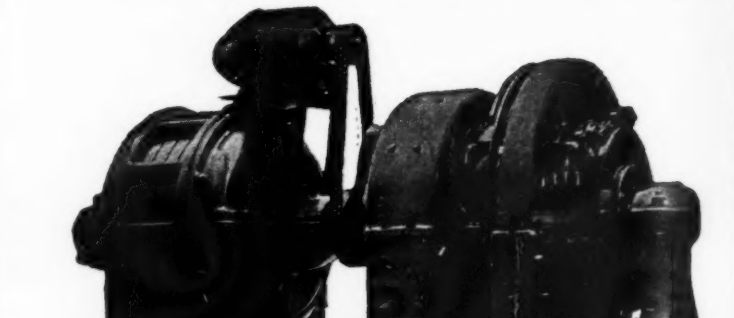
with

60 H.P. 3 ph. 60 cy. 220-440 v. A.C. Motor Driving 40 K.W. A.C. adjustable speed control unit.

MOTOR: 40 H.P. 250 V. Speed
150 to 1500 R.P.M.

Push Button Remote Control Throughout

GENERATORS—
Anodizing, Electroplating, etc.



Actual Photograph 1600 Ampere 10 to 60 Volt D.C. Generator, separate excited, driven by 3 phase, 60 cycle 220/440 Volt A.C. Motor.

2—1600 Amp. Gen. Elec. 10 to 60 Volts.

2—1600 Amp. Westinghouse 7½ to 30 Volts.

2— 800 Amp. Westinghouse 7½ to 60 Volts.

Full Range Voltage Variation, Separate Excited.

AC GENERATORS

200 KW G.E.	600
150 KW G.E.	720
100 KW G.E.	600
100 KVA West.	600
75 KVA West.	900
25 KVA West.	1800

BELTED AND MOTOR DRIVEN DC GENERATORS

200 KW West.	600 volts
80 KW El. Dy.	250 volts
60 KW G.E.	600 volts
50 KW West.	125 volts
45 KW West.	250 volts
30 KW El. Dy.	600 volts
40 KW Cr. Wh.	125 volts
30 KW West.	125 volts
25 KW West.	125 volts
25 KW G.E.	250 volts
20 KW G.E.	125 volts
15 KW West.	125 volts

16 additional Motor Generator Sets. 125 volts-250 volts, 600 volts direct current down to 1 KW.

MISCELLANEOUS

7x6 Ing.-Rand Air Compressor.
12½x12 American Air Compressor.

1 Year Guarantee!

Completely Shop Reconditioned and Tested Before Shipment

New York City's Largest Stock Electrical Equipment

L. J. LAND & CO.

146 GRAND ST. *CAnal 6-6976* NEW YORK, N. Y.

READING, PA.
10TH AND EXETER STS.

YORK, PENNA.
227 NORTH GEORGE ST.

HERE'S a good idea of the way O'Brien functions as a single source of supply for all your equipment needs: A customer wanted a complete power plant. We found what he desired down to the smallest pump . . . steel buildings, 2-500 H.P. boilers with stokers, coal and ash handling equipment, boiler feed pumps, feed water heater, all piping and accessories. Plus 937 KVA and 1875 KVA steam turbine generator sets, complete with condensers, pumps; switchboards. Plus a complete production and maintenance machine shop. Plus a 100 ft. steel stack and a 50,000 gal. steel water tank on steel supports. We purchased the entire plant, dismantled it, sold it to the customer and shipped it 500 miles. The complete plant was re-erected at destination under O'Brien supervision. In 5 month's time the plant was running without a hitch in its new location. If you want to buy or sell a complete plant or order a few machines—call O'Brien.

MOTOR GENERATOR SETS

1—250 K.W. General Electric MPC, 230 V., 400 H.P. Synchronous 3/60/2300/1200 RPM
1—200 K.W. Crocker Wheeler 240 volt 900 RPM Synchronous 2/60/2300/900 RPM
1—100 K.W. Crocker Wheeler 250 V., 1200 RPM Syr. 3/60/440
1—94 K.W. G.E. type MPC 1600 Ampere 60 volt 1200 RPM, 150 H.P. G.E. Type IK Motor 3/60/220/440/2300/1200 RPM.
1—75 K.W. General Elec. 250 V Squirrel Cage 3/60/440/1200
1—50 K.W. G.E. 125 V. 720 RPM Squirrel Cage 3/60/2300
1—50 K.W. Westinghouse 125 V. Synchronous 3/60/440/1200
1—10 K.W. Crocker-Wheeler Balancer Set 125 volt.
1—5 K.W. General Electric 125 V. 3/60/220/440/1800
1—3.6 K.W. Eager 600 Amp. 6 volt 300 Amp. 12 volt 3/60/220

STEAM ENGINE GENERATOR SETS

1000 KVA West.—Skinner Uniflow 3/60/440
750 KVA G.E.—Skinner Uniflow 3/60/2300
400 KVA Allis-Chalmers Corliss 3/60/480
325 KVA G.E.—Chuse Uniflow 3/60/220/2300
300 KVA G.E.—Ames Uniflow 3/60/480

STEAM TURBINE GENERATOR SETS
Condensing—A.C.

2—5000 K.W. Westinghouse 3/60/2300/3600 RPM.
2—5000 K.W. G.E. 3/60/2300/3000 RPM.
1—4000 KVA Allis Chalmers 3/60/2300/3600 RPM
1—3125 KVA Gen. Elec. 3/60/2300/3600 RPM
1—1560 KVA Westinghouse Bleeder 3/60/480
1—750 K.W. Allis Chalmers 3/60/480/3600
1—625 K.W. Allis Chalmers 3/60/480/3600
1—500 KVA West. Geared, 3/60/2400/6000—900 RPM
3—500 KVA Gen. Elec. Bleeder 3/60/220/3600 RPM
1—250 KVA Worthington Moore Bleeder 3/60/220
1—150 KVA Westinghouse 3/60/240/3600 RPM
1—375 KVA Allis Chalmers 3/60/240/3600 RPM
2—75 KVA Allis-Chalmers 3/60/240/3600 RPM

500 KVA WESTINGHOUSE TURBO

New 1929 **Used 3 months**

500 KVA Westinghouse Turbo Non-Condensing Generator, 3/60/480 Volt Geared 6000/900 RPM. 150 lb. ISP 5 lb. B.P. direct connected exciter, all accessories on foundation Phila. Desire to move quickly, priced accordingly. Prints, specifications on request —subject prior sale.

Everything from a Pulley to a Power House

THE O'BRIEN MACHINERY CO.

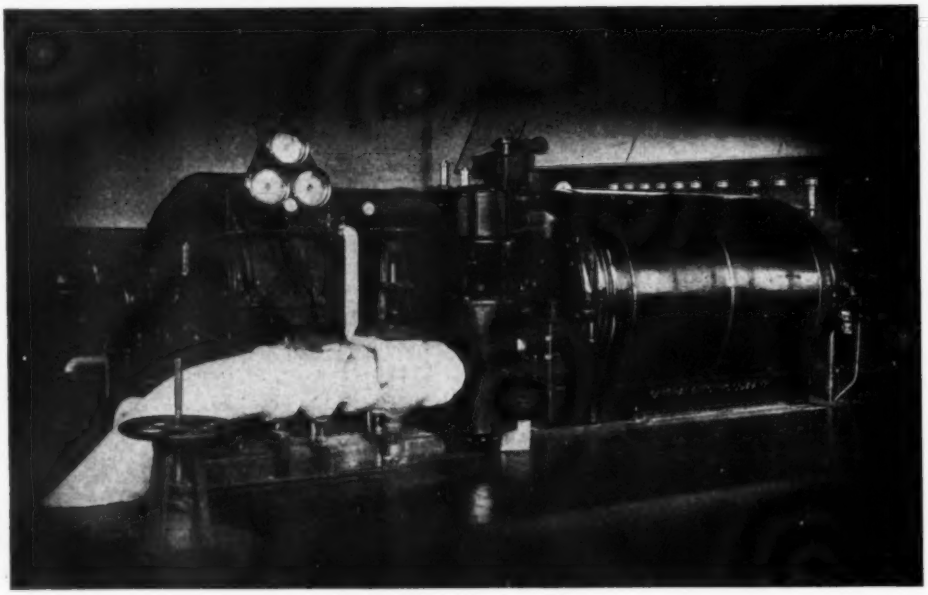
PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

113 NORTH THIRD STREET • PHILADELPHIA 6, PENNA.

WAREHOUSES AND SHOPS—2820 EAST TIOGA STREET . . . 1224 NORTH FRONT STREET . . . 5534 HAVERFORD AVENUE

BELL TELEPHONE: MARKET 4180 CABLE ADDRESS: OBRIEN PHILA

3125 KVA CONDENSING TURBINE-GENERATOR UNIT



ACTUAL PHOTOGRAPH

AVAILABLE IMMEDIATE DELIVERY

3125 KVA — 2500 KW 80% P.F. General Electric, 3 phase, 60 cycle, 2300 volt, 3600 RPM condensing turbine-generator unit, 180-200# I.S.P., 500° T.T., equipped with surface condenser, panels and instruments.

Excellent condition—a complete installation.

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

7800 KVA Westinghouse condensing 200 lb. pressure, 2300 volts, 1800 RPM complete with either surface or jet condenser.

1250 KVA Westinghouse condensing 175-200 lb. pressure, 2300 volts, complete with surface condenser.

1875 KVA G.E. condensing 175-200 lb. pressure, 500° T.T., 6600 volts, 3600 RPM complete with condenser.

937 KVA Allis condensing 150-200 lb. pressure, 475° T.T., 2300 volts, 3600 RPM complete with direct connected exciter, surface condenser and auxiliaries.

625 KVA G.E. condensing 200 lb. pressure, 2300 volts, 3600 RPM complete with condenser and auxiliaries.

375 KVA G.E. condensing 150-200 lb.. pressure, 100° SH. 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

375 KVA (2) G.E. non-condensing, 150-175 lb. pressure, 5 lb. back pressure, 2300 volts, 3600 RPM each complete with direct connected exciter.

125 KVA G.E. non-condensing, 110-125 lb. pressure, 0-10 lb. back pressure, 240 volts, 3600 RPM complete with switchboard.

ENGINE-GENERATOR UNITS

Direct Current

1000 KW Westinghouse, 250 volts, 514 RPM generator direct connected through reduction gear to Westinghouse condensing turbine, 150-200 lb. pressure, equipped surface condenser

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to a 14" x 18", 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. back pressure, complete with switchboard.

400 KW G.E. 125 volts, 165 RPM generator direct connected to a 26" x 28" Elliott Ridgway Unaflow non-condensing engine.

300 KW Westinghouse, 250 volts, 175 RPM generator direct connected to a 24" x 26" Skinner Unaflow non-condensing engine.

150 KW General Electric, 240 volts, 200 RPM generator direct connected to Ames Unaflow non-condensing engine.

75 KW, 125 volt, 1800 RPM Westinghouse direct current non-condensing turbine-generator unit.

ROTARY CONVERTERS

1500 KW Westinghouse synchronous 250 volts, direct current—6 phase, 60 cycle alternating current, 514 RPM.

750 KW G.E. synchronous, 600 volts direct current, 6 phase, 60 cycle alternating current, 1200 RPM.

330 KW G.E. synchronous, 600 volt direct current, 6 phase 60 cycle alternating current, 1200 RPM with 2300 to 408 volt transformers.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

312 KVA G.E. 2300/480 or 240 volt, 200 RPM generator direct connected to a Chuse 4-valve non-releasing Corliss engine.

312 KVA Elliott 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

250 KVA Westinghouse, 2300 or 480 volts, 200 RPM generator direct connected Nordberg Unaflow engine.

75 KW 80% P. F., Elliott 480 volts, 225 RPM generator direct connected Elliott 4-valve engine.

MOTORS

—3 phase, 60 cycle

900 HP G.E. 240 volts, 900 RPM synchronous.

500. HP 80% P.F., G.E., 240 volts, 900 RPM synchronous motor with direct connected exciter.

250 HP (2) G.E. form M, 440 volts, 450 RPM three-bearing slip ring.

150 HP (5) G.E. form K, 2200 volts, 580 RPM squirrel cage.

125 HP 80% P.F. Elec. Mchy, 440 volts, 400 RPM synchronous.

60 HP G.E. 220 volts, 900 RPM squirrel cage induction complete with starting compensator.

50 HP G. E. type I, form M, 2200 volts, 1200 RPM slip ring.

50 HP Allis-Chalmers, 440 volts, 600 RPM squirrel cage.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers, 600 or 275 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volt, 300 RPM synchronous motor.

SPECIALS

2000 KVA G.E. 3 phase, 60 cycle, 480 volt, 300 RPM alternating current generator.

528 HP Heine A.S.M.E. code water tube boiler 350# pressure, 635°F., complete with stoker, superheaters —a complete installation— modern and practically new.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

165 KW Electric Machinery 3 phase, 60 cycle, 2400 volt, 514 RPM belted generator.

SYNCHRONOUS CONDENSERS

1350 KVA

Total Capacity

750 KVA and 600 KVA G.E. type ATI, 3 phase, 60 cycle, 240 volts, 900 RPM synchronous condensers each complete with direct connected exciter, switchboard panel with instruments. Are in A#1 operative condition — still on original foundation for operating test.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

REBUILT POWER EQUIPMENT

READY TO SHIP!

SPECIAL AIR COMPRESSORS

1—599 CFM Ingersoll Rand Imperial type 10XB-2 horiz. 2 stage, size 16 x 14 x 10 x 14, 100# pres. complete with 104 HP AC motor.
1—388 CFM Ingersoll Rand Imperial type 10XB-2 horiz 2 stage, size 16 x 14 x 10 x 14, 100# pres. complete with 152 HP AC motor.

ROTARY CONVERTER

2—400 KW, G.E., 250 v. 600 rpm., 2300/3/60 A.C.

MOTOR GENERATOR SETS

1—150 kw. Crocker Wheeler 250 v. DC. 600 rpm. dir. con. to 220/440 or 2200 v. syn motor.

125 kw. Cr. Wh. 250 v. D.C. 1200 rpm., 220/440 v. 3 ph. 60 cy. Ind.

ENGINE GENERATOR SETS

225 kw. Elec. Machy 2200 or 220 v. 3 ph. 60 cy. dir. con. Ideal Steam.

1—225 kw. Elec. Machy. 2200/220 or 440 v. 3 ph. 60 cy., 200 rpm. dir. con. Ideal Engine 4 valve non-releasing.

100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450 per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

1—150 kva. Wagner 220/440 v. 3 ph. 60 cy. 600 rpm.
1—250 KW 480 V. 3/60, Allis-Chalmers, 150 rpm.
1—62½ KW West., 2300 v. (can be reconnected for 220/440 v.), 3 ph., 60 cy., 1200 rpm.

A.C. MOTORS—3 ph. 60 cy.

Qu.	HP	Make	Volts	Speed	Type
18	½	G.E.	220	900	K
33	½	G.E.	220	1140	K
19	1½	Ilg.	220	490	
12	3	Louis Allis	220/440	1200	OK
1	7½	Louis Allis	220/440-170/1750		F.S.—(Adjusto speed)
1	40	G.E.	220/440/550	1200	I-8
1	40	West.	440	900	C
1	40	W. El.	440	720	CS
2	40	West.	220	600	——
2	40	West.	220	514	CS
1	40	Am. El.	440	685	——
		(Vertical-ball bearing)			
2	40	Am. El.	440	685	PK
		(Enclosed-ball bearing)			
1	40	West.	220	600	CS
2	40	West.	440	1800	MS
1	40	G.E.	220/440	1160	K
1	40	Triumph	440	860	13-12
1	40	G.E.	440	860	KT
1	50	Chandeys.	220/440	1800	——
1	50	Al. Ch.	220	1200	——
1	50	G.E.	440	1200	KT
1	50	Triumph	440	1200	B-12
1	50	G.E.	440 only	1200	I
3	50	A.E.C.	440	900	PK-enclosed
1	50	A.E.C.	440	900	vertical
3	50	West.	220	720	——
1	50	West.	220	514	CS
1	50	Reliance	440	1200	——
7	50	Al. Ch.	440	1800	AN
2	50	West.	440	1800	C
1	50	West.	440	1120	C

A.C. MOTORS—3 ph. 60 cy.—con't

No.	Hp.	Make	Volts	RPM	Type
2	7½	G.E.	220/440	900	KG-326
		(totally enclosed)			
1	50	G.E.	440	900	I-8
3	50	Wagner	440	850	——
1	50	West.	440	850	CCL
1	50	West.	440	650	CCL
2	50	West.	220	600	CS-752C
1	50	G.E.	220/440	1200	HI
1	50	West.	440	690	C
1	50	G.E.	220/440	450	I
1	50	G.E.	220/440	400	
1	50/60	West.	440 only	1800	MS
1	50/60	G.E.	440	1200	I
1	50/100	West.	440	345/700	CS
1	54	Al. Ch.	440	900	——
1	60	Al. Ch.	440	1200	——
1	60	West.	440	900	C
2	60	West.	220	720	CS
2	60	G.E.	550	660	I-10
2	60	Triumph	220	430	C16
6	60	Al. Ch.	440	1800	AN
1	60	G.E.	220	720	I-8
1	60	Cr. Wh.	220	670	122Q
6	65	Al. Ch.	440	1800	AN
3	65	G.E.	440	1800	KT-347
1	75	W. El.	440	1800	CS
1	75	Wagner	140	1800	——
4	75	Al. Ch.	440	1800	AN
1	75	West.	440	1200	MS
1	75	G.E.	220/440	1150	I-8
1	75	U.S.Mtr.	220/440	900	SC
1	75	West.	220	600	CS
1	75	G.E.	220	900	I-8
1	75	G.E.	440/550	720	I-10
1	75	Cr. Wh.	220	514	124Q
1	100	U.S.Mtr.	220/440	1160	SC
2	100	G.E.	550	900	I-10
1	100	West.	220	720	CS
1	100	G.E.	2200	450	I
1	100	West.	220	1750	——
1	100	G.E.	220	1200	I-8
1	100	Al. Ch.	220	600	——
1	100	Cr. Wh.	220	575	124QB
1	100	G.E.	440	400	I-K
2	100	West.	220	1200	CS-Vertical
1	100	West.	240	900	——
1	100	G.E.	2300	580	I-15
1	125	West.	2300	1170	CS
1	125	G.E.	440	514	I
1	125	G.E.	440	450	I
1	125	G.E.	220/550	400	I
1	125	Wagner	440	1800	——
1	125	Cr. Wh.	220	720	124QR
1	125	Al. Ch.	2200	1165	ARV
1	150	West.	2200	720	——
1	150	G.E.	220/550	514	I
1	150	G.E.	440	600	I
1	150	G.E.	440	514	I
1	150	G.E.	220/550	450	I
1	150	Wagner	440	1800	——
1	150	G.E.	550	575	I-K
1	150	West.	2200	327	LC
1	150	G.E.	2200	600	I-12
1	200	G.E.	440	900	KT
1	200	West.	220 or 440	720	——
1	200	G.E.	220/550	600	I
1	200	G.E.	220/550	514	I
1	200	West.	2200	900	CS-967A
1	200	West.	220	580	CS
4	200	Al. Ch.	2300	347	AN
1	225	G.E.	2200	200	syn.
1	250	G.E.	440	1200	Open
1	250	G.E.	2200	1175	I-6
1	800	G.E.	6600	1200	——
2	1000	G.E.	2300	509	K

SLIPRING MOTORS—3 ph. 60 cy.

No.	HP	Make	Type	Volts	RPM
1	1500	West.	CW	2200	435
1	400	West.	CW	440/220	1170
1	400	West.	CW	2200	435
1	350	West.	CW	2200	900
1	250	West.	CW	2200	345
1	100	G.E.	I	220	450
1	100	West.	CI	220/440	1750
1	75	Cr. Wh.		220/440	875
2	60	Triumph	C-16	220/440	430
1	60	West.	HF	2200	690
1	53	G.E.	I	220/550	1165

TRANSFORMERS—1 ph. 60 cy.

No.	Kva.	Pri.	Sec.	Make	Ph.
1	250	2300	460	G.E.	
1	100	2200	110/220	G.E.	
3	100	6600	550/440/220	Pgh.	
3	50	11430/6600		Al. Ch.	
3	50	6600	575	G.E.	
1	37½	2300	220/440	Wagner	
3	37	4400	185	West. (Rotary)	
35	10	2200	110/220	G.E.	
40	10	2200	110/220	West.	
100	7½	2200	110/220	G.E. & West.	
75	5	2200	110/220	West & G.E.	

VARIABLE SPEED MOTORS—230 V. D.C.

No.	Hp.	Make	Type	RPM
1	250	Cr. Wh.	CMC	200/400
2	(new) 75	Elec.	Dy.	750/1750
1	50	West.	SK-163	390/980/1170
1	35	West.	sk-140	675/1350
1	30	West.	sk-123	850/1700
1	30	G.E.	RLC	450/900
4	20	West.	sk-IOOL	750/1500
2	10	G.E.	le	625/1250
1	5	G.E.	CD-85	450/1800
1	3.75/7.5	West.	sk-111	300/1200
2	3	Jantz Liest	BI	650/1950

25 CY. MOTORS 220/440 V. A.C.

Qu.	HP	Make	Type	RPM
1	75	G.E.	I-4	900
1	75	Allis-Chalmers	AN	900
6	40	Allis-Chalmers	AN	900
1	35	Western Elec.	SL13B	600
1	35	West.	M	900
1	30	West.	C	720
7	30	Allis-Chalmers	AN	900
2	25	West.	MS	715
9	10	Allis-Chalmers	AN	900

KNIFE SWITCHES

18—300 Amp. S.P.S.T. 7500 v.
6—300 Amp. S.P.S.T.B.C. 15000 volts G E.

INDUSTRIAL TRUCKS

1—Elwell Parker Tow Tractor 2000 lb. with batteries.
1—Baker Tow Truck with batteries.

LATHE

1—Prentiss Engine Lathe, bench lathe, 7½" sw., length of bed 6', length 4½', screw cutting.

PUMP

1—6x8 Deming Triplex Pump, 166 g.p.m., 150 lbs. pressure, 335' head, 20 H.P. A.C. or D.C. Motor.

SCALES

9—Howe Scales, 3 beams (2 at 200# each—1 at 50#) Platform 14½" x 22", height 28", length 33½", width 16", approximate capacity 500#.

TACHOMETER

1—Tachometer, model C Hickok Generator, 0/2000 rpm.
1—Flexible coupling
1—Hickok Meter, 200 rpm.
2—75 HP Van Duraloy Tachometers

Large Stock—CIRCUIT BREAKERS—METERS — CURRENT AND POTENTIAL TRANSFORMERS—POTHEADS—RELAYS—METERS — SAFETY SWITCHES — DISCONNECT SWITCHES — U-RE-LITES — PULLEYS — REACTORS.

WRITE, WIRE OR PHONE YOUR ELECTRICAL REQUIREMENTS

DUQUESNE ELECTRIC & MFG. CO.

PITTSBURGH 6, PA.

1904—40 Years Continuous Service to Industry—1944

EQUIPMENT READY FOR IMMEDIATE DELIVERY

WRITE • PARTIAL LIST ONLY • WIRE

DIRECT CURRENT MOTORS

115 Volts

H.P.	Mfr.	Type	Speed
40	G.E.	RC 32	1150
20	Whse.	SK-120	650
20	L. Allis	WD-20 (Vert.)	1000
15 B. Brg.	Cr. Wh.	CCM	850
10	Whse.	SK-60	1150
10	Whse.	SK	850
7½	G.E.	RC	1750
¾ (6)		BD Vertical	3450

Many other smaller motors, too numerous to list.

DIRECT CURRENT MOTORS

230 Volts

H.P.	Mfgr.	Type	Speed
75 (2)	Reliance	310T	1450
65	Cr. Wh.	CMC 65H	600
61/70 (3)	G.E.	CDM	352/400
50	Cr. Wh.	CMC	700
35	G.E.	RF	500/1500
30	Reliance	131T	1450
30	Imp.		850
30/35	G.E.	CDM	176/200
25	G.E.	DLC	750
25	G.E.	CVC	1200
20	Reliance	92T	1450
20	Whse.	SK-111	720
20	Burke	WA-4	900
20	G.E.	CD-105	600
20	G.E.	CQ	1700
20	Whse.	SK-100L	900
20	Whse.	SK	1700
20	Al. Ch.	E-100	1150
20 (2)	G.E.	RC27B	3450
20	Triumph	24F	1750
20	G.E.	RC-11	1150
20	Elec. Dyn.		950
20	Louis Allis		850/1700
15	West.	SK-601	1700
15	Roth	7-S	1150
15 (2)	G.E.	RC-30	850
15 (10)	Reliance	Ball bearing	850
15	Elec. Dyn.		600
15	Whse.	SK-80	1100
15	G.E.	RC-31	1100
15	Cr. Wh.	CM	1150
15	G.E.	RC-30	850
15	Imp.	HV-1	850
15	Imperial		575
12½	West.	SK	400/1400
10	Whse.	SK-63	1150
10 (2)	G.E.	LC	1000/1500
10	W. Elec.	ER3A	1000
10	G.E.	RC-29	850
10	Cr. Wh.	CM	850
10	Whse.	SK-70	850
10	Whse.	SK-90	600
10	G.E.	RC-49	850
10 (2)	G.E.	CVC-115	700
7½	G.E.	RC	3450
¾ (16)	G.E.	BD Vert.	3450

The above listing is a very small part of the items in stock.

DIRECT CURRENT GENERATORS

KW	RPM	Volts	Make
115	600	250	Cr. Wh.
100	1000	125	G.E.
100	900	125	Whse.
75	1750	250	Reliance
65	720	250	Cr. Wh.
30	1750	250	Reliance
25	490	125	G.E.
20	1750	250	Reliance
20	900	125	Whse.
15 (2	1140	250	Reliance
15	1140	125	G.E.
10	1140	250	G.E.
10	1750	125	Whse.
6	900	125	Whse

Also a large assortment of special voltages. We specialize in building Motor Generator Sets to your specifications.

MOTOR GENERATOR SETS

KW	Make	D.C. Volts	Drive
150	Westgh.	230	3/60/2300-550
50	G.E.	125	3/60/2300
25	G.E.	125	3/60/440
35	Burke	125	3/60/220
25	Burke	125	3/60/550
15	G.E.	125	3/60/440
6 (2)	G.E.	75	3/60/220
3	Roth	125	3/60/220
3	Chand.	6-12	3/60/220
2	Cont.	120	3/60/220

D.C. STEAM DRIVEN GENERATORS

1—50 KW Crocker Wheeler 125 Volts, 2800 RPM direct coupled to a 80 HP Terry Turbine, 100 lb. pressure.

1—25 KW Engberg 230/125 Volts, 400 RPM, direct connected to a vertical Engberg Reciprocating Engine.

EXTRA SPECIAL

NEW! NEW! NEW!

New, open and totally enclosed, fan cooled 3 phase 60 cycle motors, in various makes and speeds, from 3 HP to 60 HP.

DIRECT CURRENT CRANE AND MILL MOTORS

	Mfr.	Type	Speed	Volts
G.E. (2)		CO 1832	600	230
G.E. (2)		CO 1811	600	230
G.E. (2)		CO 1809	550	115
G.E.		CO 1807	800	230
G.E.		CO 1808	600	550
G.E.		CO 1806	875	230
G.E.		CO 1806	575	115
G.E. (2)		CO 1803	600	230
G.E. (2)		CO 1805	575	230
Whse.		K-10	525	230
West. (6)		K1	950	230
West. (6)		K1	950	550
West.		HK3	800	230
West.		HK2	850	230
Whse. (5)		HK-5	700	230
West.		CK-9	335	230
North.		K-T 35 H.P.	800	230
P & H		12x8	430	230

The above items are constantly changing. Suggest you let us know your needs, if the item you want is not listed.

SYNCHRONOUS MOTORS

3 Phase 60 Cycle

H.P.	Mfr.	Volts	Type	Speed
250	Whse.	440		1200
250	G.E.	440	ATI-PB	720
187½	Whse.	220		600
175	G.E.	220	ATI-PB	514
175	West.	440		900
125	Cr. Wh.	220		900
100	Whse.	440/220		900

AC GENERATORS

3 Phase 60 Cycle

KVA	Mfr.	Volts	Type	Speed
300	G.E.	600	ATB-PB	600
225	G.E.	480	ATB-PB	720
225	Whse.	440/22	Pedestal	1200
225	West.	2300		600
200	Lincoln	220		720
187½	Whse.	240	Pedestal	600
150	G.E.	240	ATB	514
150	Al. Ch.	440		900
100	Cr. Wh.	240		900
100	West.	240		900
7½	G.E.	220	AS	1800

SLIP RING MOTORS

3 Phase 60 Cycle

H.P.	Mfr.	Type	Volts	Speed
600	Whse.	CW	2200/ 550/440	590
400	G.E.	IM	2200/ 550/440	720
250	G.E.	IM	440	514
200	Cr. Wh.		2200	600
200	Whse.	CW	200	1150
150	G.E.	IM	2200	600
150	G.E.	IM	550	600
100	Whse.	CW	440	600
75 (3)	G.E.	MT	440/220	1200
75 (2)	Cr. Wh.	SR	440/220	1200
75	Whse.	CW-746	440/220	1200
52	G.E.	ITC5012	440	900
50	G.E.	IM	440	900
50	Cr. Wh.		440	900
50 (2)	G.E.	MT	440/220	900
50	G.E.	I-M	440	1200
50	G.E.	MT-556Y	220	600
40	Al. Ch.		440	900
40	G.E.	MT	220	1200
40	Whse.	CW	2200	1750
40	Whse.	CW-636A	220	1160
40	G.E.	MT	550	900
40 (2)	Whse.	CW	550	900
37	G.E.	ITC5012	220	600
35	Ridgway		2200	600
35	G.E.	IM	2200	1200
35	G.E.	IM	2200	900
35 (2)	G.E.	IM	220	720
30	Fks. M.		220	1200
30	G.E.	MT 332	220	900
30 (2)	G.E.	MT-336	220	900
30	G.E.	MT-342	220	720
27	G.E.	IM	440	600
25	Al. Ch.		550	1800
25	G.E.	MT 536	550	720
25	Diehl	KK14R	220	850
20	Fks. M.		220	1200
15 (2)	G.E.	IM	220	1200
15	Al. Ch.	ARY	550	1200
15 (2)	G.E.	IM	220	900
15	G.E.	MT 312	220	900

A large assortment of smaller sizes as low as 1½ H.P.

SQUIRREL CAGE

3 Phase 25 Cycle

H.P.	Mfr.	Type	Volts	Speed
125	Whse.	CS	440	720
100 (2)	G.E.	IK	440	500
75	Whse.	CCL	550	480
40 (3)	Al. Ch.		550	3400
30	Whse.	CS	440/220	720
25	West.	MS	440	720
25	G.E.	IK	440	720
25	Ideal	A	440	720
25	West.	CS	440	720
20	G.E.	IK	220	720
20	West.	CCL	220	1500
20	Wagner		440	1500
20	West.	CS	440	600
20	G.E.	IK	440	1500
17½	Lincoln		220	1500
15	Whse.	CCL	440	500
15	Wagner	17TBP	440/220	1500
15	Ideal	A	440	1500
*15	Cent.	RS 30S	220/110	1500
15	Ideal	AVE	440	720
15 (2)	Burke		440	1500
10	G.E.	IK	220	500
10	G.E.	KT 958	440/220	1500
10	Whse.	CCL	220	1500
10	Whse.	CS	440/220	750
10	Ideal	A-80	440	750
10 (2)	Whse.	CS-567	440/220	750
10	Whse.	CS	440/220	500
5 (2)	G.E.	KT	440	1500
5 (3)	West.	CS	440	1500

*Single Phase.

A large assortment of smaller sizes.

SPECIAL

Two 15x36 Cutler - Hammer Rectangular Magnets.

SPECIAL! SPECIAL!

A.C. GENERATORS

31½ KVA, 25 KW, 120/208 V., 1200 RPM. Ball bearing with direct connected exciters and rheostats. Adaptable for direct connection to diesel, gasoline or electric motor drive.

SLIP RING

3 Phase 25 Cycle

H.P.	Mfr.	Type	Volts	Speed
150 (2)	G.E.	IM	440	600
150	Triumph	3-bearing	2200	720
100	G.E.	IM	440	750
25	G.E.	MTC 5323	440	750
15	G.E.	MTC-Hoist Duty	440	675
15	Whse.	HF	440	710
10	G.E.	MT 323	220	750
10	G.E.	MT 523	220	750

A partial listing.

SQUIRREL CAGE MOTORS

60 Cycle 3 Phase

H.P.	Mfr.	Type	Volts	Speed
300	G.E.		2200	600
225 (3)	Whse.	IK	2200	720
225	G.E.	CS	440	900
200	C.W.	IK	440	900
200	G.E.	IK	440	900
200	Burke	EM50	440	600
200	G.E.	IK	440	600
200	G.E.	IK	2200	514
200	Cr. Wh.		440	720
150 (2)	G.E.	IK	440	720
150	Al. Ch.		2200	1800
150	Al. Ch.		440	1800
150	Cr. Wh.		2200	600
150	Burke	EM209	440	720
150	Al. Ch.		440	600
125	G.E.	IK	440	720
125	Cr. Wh.		2200	600
100	G.E.	IK	550	720
100	G.E.	IK	550	600
100 (4)	G.E.	I-L	550	720
100	G.E.	IK	550	900
100	G.E.	KT	550	900
100	G.E.	KT346	440	1200
100	West.	CS	440	720
75	G.E.	I-L	440	360
75	G.E.	I-L	440	514
75	Al. Ch.		220	720
75	G.E.	I-K	440	720
75	G.E.	I-L	550	720
75 (2)	West.	CS	440	900
75	G.E.	Vert.	440	1200
60	Al. Ch.	Sp. pr.	2300	1800
60 (2)	G.E.	IK	440/220	1200
60	F.M.	H	440	900
50	Al. Ch.		2300	900
50	Ridgway		2300	600
50	G.E.	KT342	2300	900
50	West.	CS	440	900
50 (2)	West.	CS	220	720
50	G.E.	KT552	440	720
40	G.E.	K	550	900
40 (2)	Al. Ch.		440	900
40	G.E.	I-L	440/220	900
40	Cr. Wh.		220	1200
40	F. M.	H	220/440	900
40	G.E.	KT342	440/220	900
40	Al. Ch.		440	1200
40 (3)	Al. Ch.	B. B	550	3450

A large assortment of smaller sizes too numerous to list.

ALL EQUIPMENT GUARANTEED FOR ONE YEAR

★ WANTED TO BUY: Stationary Air Compressors, Belt or Steam Driven

Benjamin's for Motors, Inc.

ESTABLISHED 1904

WIndsor 5-1700

12th AVENUE AND 37th STREET ★ BROOKLYN, 18, N. Y.

ELECTRICAL and POWER EQUIPMENT

MOTORS

230 VOLT, DIRECT CURRENT

CONSTANT SPEED

Qu.	H.P.	Make	Type	RPM
1	450	Al. Ch.	Int	425
1	150	G.E.	RC	1700
1	125	G.E.	DLC	550
2	100	Al. Ch.	CPD INT	1000
1	100	Rel.	1050T	500
1	75	G.E.	DLC	525
2	50	West.	SK160	565
1	40	G.E.	RC15A	700
1	30	West.	SK120	975
2	30	G.E.	RC31B	1150
1	30	West.	SK140	600
3	25	West.	SK120	825
8	25	G.E.	RC31	1150
1	25	West.	SK	850
1	20	G.E.	RC11	1150
3	15	G.E.	RC10	1150
5	15	West.	SK 100 I	675
7	15	Rel.	92T TE.BB	850
2	15	West.	SK90	850
4	15	G.E.	RC11	850
3	10	G.E.	RC29	1150
8	10	G.E.	RC29	850
3	10	West.	SK80	750
2	7½	G.E.	RC	1150
9	5	West.	SK40	850

VARIABLE SPEED

Qu.	H.P.	Make	Type	RPM
3	150	Diehl.	K15	400/800
3	25/100	G.E.	MPC	300/600
1	110	West.	SA	650/1050
1	100	West.	SA	250/350
1	75	G.E.	LC	650/900
2	40	G.E.	LC	650/1300
3	30	West.	SK140	600/1200
1	25	West.	SK	400/1200
1	15	West.	SA9	300/1200
1	15	West.	SK103	400/1600
2	15	West.	SK	500/1500
2	10	Al. Ch.		500/1000

SQUIRREL CAGE

A.C. 3 PH 60 CYCLE 2300 VOLT

Qu.	H.P.	Make	Type	RPM
1	150	G.E.	IK	900
2	100	West.	CS774C	900
1	100	G.E.	IK	514

220/440 VOLT

1	125	Cr. Wh.	125Q	900
1	50	Wagner	22VRM	600
1	40	Rel.		900
5	30	Wagner	19VRM	720
2	20	Rel.	120AA	900
1	20	Rel.	178AA	720
1	15	Gent.	SCN19	1200
3	3	Imp.	TE. BB	3600
5	1	Wagner	BB	1200

TRANSFORMERS

60 CYCLE, SINGLE PHASE

2—500 Kva Moloney 2300/230/115 oil cooled.

3—100 Kva Pitts. 2400/240/120 oil cooled.

4—5 Kva Wsghse 2300/230/460 air cooled.

6—3 Kva Gen. Elec. 2300/230/115 air cooled.

GENERATORS

230 VOLT DIRECT CURRENT

45 KW Diehl K 18 550 RPM.

100 KW Ft. Wayne MPL 550 RPM.

100 KW GE MPL 600 RPM.

200 KW Sprague 525 RPM.

200 KW West. 500 RPM.

250 KW West. 500 RPM.

750 KW GENERATOR

750 KW—Ridgeway, 1800 RPM, 230 V., D.C., Compound Interpole, two bearing, PRACTICALLY NEW.

BOILERS

4—1010 HP. Watertube boilers, 250 lb. pres., steel headers, long drums. ASME Code—complete with oil burning equip., pumps, Foster superheaters and accessories.

2—316 HP. Heine Watertube boilers, 160 lb. pres., hand fired.

2—684 HP Edgemoor Waste Heat Boilers, 200 lb. pres. complete with Economizers, Super Heaters, motor driven blowers and steel stacks.

2—500 HP Edgemoor, 200 lb. pres., ASME Code, with Riley Side Dump Stokers.

STOKER

1—Jones, 3 retort, steam actuated, underfeed, ram stoker.

CONDENSER

1—C. H. Wheeler 3650 Sq. Ft. Surface Cond. 2 pass. complete with pumps.

PUMPS

Cameron Centrifugal Purchased New 1923. Bronze fitted, mounted on common subbase for motor drive—

1—Size 14—700 RPM 4700 GPM 35′ head 60 HP.

1—Size 14—720 RPM 5500 GPM 30′ head 75 HP.

1—Size 16—350 RPM 3500 GPM 45′ head 125 HP.

All Pumps Tested Hydrostatically for 125#.

All Double Suction Volute. Gate Valves Attached.

1—Davidson 14x9¼x16 Simplex Double acting piston pattern, brass fitted.

STEEL TANK

350,000 gal. Steel Water Storage Tank 40′ high, 40′ dia.

FEEDWATER HEATER

1—Cochrane Feedwater Heater 5000 H.P., open type.

OVERHEAD CRANE

1—15 Ton, OVERHEAD CRANE, 50 ft. span overhead Travelling Crane, Electric lift, hand travel.

MOTOR GENERATOR SET

1—35 KW GENERAL ELECTRIC Motor Generator Set. 125 Volt D.C., 1200 R.P.M., R.C. Generator; Motor General Electric KT, 550 Volt, with compensator and D.C. Panel.

WATER WHEELS and GENERATORS

2—45" HERCULES Cylinder Gate Type B Water Wheels. Complete with Governors, pumps and tanks. Each direct-connected to a WESTINGHOUSE ELECTRIC Vertical Generator 800 KVA, 3 ph., 600 V. 40 cy. 150 R.P.M.

HEAT and POWER Company, Inc.
45 BOND STREET Phone: ALgonquin 4-3874 NEW YORK, 12, N. Y.

BOILERS

1—528 HP **Heine**, 350 lb. with underfeed stoker.
1—335 HP **B & W Sectional Header Boilers**, 200# pressure with superheaters, hand fired grates.
1—250 HP **Casey-Hedges**, 160 lb. pressure.
1—400 HP **Wickes** 3 drum low head boiler, 200# pressure with Chicago Spreader stoker. Installed 1932.
1—90,000# per hr. **Badenhausen Boiler**, 354# pressure.
1—357 HP **HEINE** with Riley Underfeed **Stoker.**
2—600 HP **B & W** sectional header boilers, 200# pressure.
2—300 HP **Heine** 175# pressure.
2—492 HP **Sterling Boilers**, 160# pressure.
6—600 HP 200# pressure **O'Brien boilers.**
1—394 HP **Sterling Boiler** chain grate stoker, 160# pressure.
1—585 HP **Erie City** vertical boiler 185# pressure, Type E stoker.
2—253 HP **Sterling Boilers**, 160# pressure with oil burners.
1—444 HP **Union Iron Works Boiler**, 225# pressure.
2—500 HP **Edge Moor Boilers** 200# pressure.
4—500 HP **Voigt Water Tube Boilers** 175# pressure with chain grate stokers and all auxiliaries.
1—440 HP **B & W Sectional Head Boiler** 150# pressure, underfeed stoker.
1—522 HP **Sterling Boiler** 200# pressure with **Firite Stoker.**
2—600 HP **Stirling Boilers**, 200 lb. pressure.
1—484 HP **Springfield Boiler**, 250# pressure oil burners.
1—**Complete Power Plant** consisting of 2—309 HP **Heine Marine Boilers**, 223# pressure and 2 General Electric Turbines with all auxiliaries.
8—150 HP **HRT Boilers**, 150# pressure.
4—750 HP **Bigelow Hornsby** 225# pressure with pulverizers.
4—1010 HP **Heine** watertube boilers 250# pressure.
1—400 HP **Connelly Boiler** 160# pressure with new tubes and auxiliaries.
2—84" x 20' **HRT Boilers**, 150# pressure all auxiliaries.
1—150 HP **HRT**, 125# pressure, rebuilt and guaranteed.
56—50 HP **Vertical Boilers** 150# pressure all auxiliaries.

TURBINES

1—5000 KW **Westinghouse** 1800 RPM 3-60-2300 volts Surface Condenser all auxiliaries.
1—3200 KW **Allis-Chalmers Condensing Turbine** with auxiliaries.
1—2500 KW **General Electric Condensing Turbine** with auxiliaries.
1—2500 KW **General Electric Turbine** 400# pressure. Surface condenser.
1—1000 KW **Westinghouse non-condensing turbine** 350# pressure 16# back pres.
1—937 KVA **Allis-Chalmers Turbine.**
1—625 KVA **General Electric Turbine** with jet condenser.
1—2000 KW **Westinghouse Turbine** with Surface Condenser and auxiliaries 3-60-440 volts.
1—300 HP **Kerr** Non-condensing 3600 RPM **Turbine.**
1—250 KVA **Waite Turbine** either condensing or non-condensing.
1—250 KVA **General Electric non-condensing Turbine.**
1—125 KW **General Electric non-condensing Turbine.**

ENGINE GENERATOR SETS

260 KVA **Skinner** uniflow engine.
1—750 KVA **Rice & Sargent** 3-60-600 volt engine generator.
2—200 KW 250 volt D.C. **engine generator sets.**
1—250 KVA **Ridgeway** engine generator set.
2—187½ KVA **Skinner** Uniflow Engines.
17 inch by 18 inch **Skinner** uniflow engine.
1—166 KVA **Ames** Uniflow engine generator set.
1—260 KVA **Skinner** uniflow engine.
2—625 KVA **Bates-Corliss** engines.
1—48" x 150' **steel stack.**

DIESEL ENGINES

2—200 KVA **Fairbanks-Morse** Full Diesel Engine Generator.
4—312 KVA **MAN** full diesel engine generators, solid injection, 4 cycle.
1—**Busch Sulzer** Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
800 KVA **Nordberg**, full diesel engine generator.

ENGINE GENERATOR SETS

1—625 KVA **Nordberg** Uniflow engine.
1—1000 KVA **Skinner** Uniflow engine.
400 KW **Skinner** Uniflow Engine Generator set.

MISCELLANEOUS

54,000 pound **Cochrane** hot process lime and water softener.
2500 HP **Cochrane** Open Feed Water **Heater.**
1—10' x 15' **Illinois** Forced Draft Chain **Grate Stoker.**
1—#8 **Fuller Bonot Pulverizer.**
1—8 retort **Taylor**, brand new **stoker.**
1—800 HP **Hoppes** open **feedwater heater.**

SEE Fletcher FIRST!
FLETCHER SALES CO.
325 Fincastle Building
LOUISVILLE, KY.

CHICAGO ELECTRIC—GUARANTEED REBUILT EQUIPMENT

2—1500 KW MGS.
2—1500 KW Wtg. 250 d.c. dir. conn. 2250 hp. 8yn. 360 rpm. 3-60-12000/2300 V.

MOTOR-GENERATOR SETS

KW	Make	DC volts	AC volts
1500	Wtg.	250	2300 SYN
1000	G.E.	600	4400/2200
1000	Wtg.	275	4160/2300
750	G.E.	275	440
300	Al. Ch.	600	2300 syn.
250	G.E.	600	
200	3-unit	80v.DC	250 v. DC
235	Westg.	110	2200
225	Ideal	115	2200
200	Westg.	250	440/2200
150	Cr. Wh.	250	2300
150	Ideal	250	440
150	Rldg.	250	2300
100	G.E.	250	2200
100	Westg.	125	2200
100	Al. Ch.	125	440
100	Westg.	250	220/440/2200
90 HP	Westg.	110	75 Kva 3200 ac
75	G.E.	250	2200
75	G.E.	125	220
50	Al. Ch.	3-w.	2200
50	G.E.	125	4000
50	Westg.	250	2300
15	G.E.	230	220
15	Ster.	240	220
7½	Jenny	balance set	

SLIP RING MOTORS

Qu.	HP	Make	Type	Speed
1	30	Wagner	BR	850
1	30	Westg.	HF10A	860
1	15/35	Westg.	CW654C	575/1150
1	30/15	G.E.	OMT336	1155/550
1	35	F. Mse. vert.	UVA	1800
1	35	G.E.	I-M13	600
1	35	G.E.	I-M-13	600
1	40	G.E.	MT-Int.	1200
1	40	Wagner	23TBR	1725
1	40	Westg.	CW	1160
1	40	Wagner	BR	850
1	40	Westg.	HF	690
1	50	Westg.	HF11AH	1180
1	50	Al. Ch.		1160
1	50	West.	HF	860

2—1500 KW M.G. SETS

2—1500 KW Westinghouse, interpole, 250 volts, D.C. generators, speed 360 RPM, with commutating interfield poles, connected to
2—2250 KVA Westinghouse synchronous motors, 3 phase, 60 cycle, 12000/2300 volts, 360 RPM, with DC and AC switchboard equipment, excellent condition, available immediately.

FREQUENCY CHANGER

1—1400 HP General Electric type ATI-24-1250M-300 Form C, 3 ph, 60 cy. 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. synchronous motor with amort. wdg., dir/conn. to 1000 KW General Electric types ATI-10-1250M-300, 3 ph, 25 cy, 450 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. A.C. generator with amort. wdg., with 33 KW G. E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

SLIP RING MOTORS

Qu.	HP	Make	Type	Speed
1	50	F.M.	HV	720
1	50	Westg.	CW752C	690
1	50	G.E.	I-M	685
1	50	Al. Ch.	ARY	690
1	50	G.E.	I-M	600
1	50	Wtg.	CW855	570
1	50	G.E.	MTC5342	565
1	50	Al. Ch.		720
1	60	Westg.	CW	600
3	75	Al. Ch.	ARY	900
1	75	Westg.	F	720
1	75	G.E.	M-12	600
1	75/94	N. West	HW	1800
1	100	G.E.	I	600
1	100	Al. Ch. 2200 v.		600
1	100	Westg. 2200	CW	600
1	100	Westg.	HF	230
1	150	G.E.	MT	900
1	150	Westg.	CW	600
1	150	Al. Ch.		580
1	150	Wagner	BR	1140
1	150	Westg. 2200	CW	375
1	200	G.E.	1E	1200
1	200	Howell	S	600
1	200	Westg.	CW	345
1	250	Al. Ch. 2200/400		600
1	250	G.E. Slipring vert.		1200
1	300	G.E. Slipring	I-M2200	514
1	300	G.E., 3-brg.	MT-410	450
1	300	G.E. with outboard brg.	I-P	450
1	350	G.E.	MT-432V-	300
1	350	Allis C.		300

VARIABLE SPEED MOTORS 230 Volt D. C.

HP	Make	Type	Speed
1	Cr. Wh.	CM	500/1000
1	Electro-Motor		420/1680
1½	Cr. Wh.	CM	925/1210
2	G.E.	RC4	600/1000
3	Gen. Elec.	CD	1050/1700
4	Sprague	C	800/1400
5	Burke	AM12	500/1500
5	Burke	Wam12	960/1950
7½	Reliance	46T	875/1200
12½	G.E.	C	700/1400
20	G.E.	RF12	500/1500
20	G.E.	RLC	500/1500
20	G.E.	RC11	500/1500
25	G.E.	DLC	500/1000
35	Wtg.	SK140	500/1500
40	G.E.	LC	825/2000
40	Chandysn.		250/1500
50	Gen. Elec.	RC14	500/1500
50	G.E. Sprague	C	575/1000
50	Westinghouse	SK	500/1000
60	Electro Dyn.		450/900
90	Westinghouse	SK	575/1150
35/100	G.E.	CD165	425/850
100	Gen. Elec.	CD147	450/1150
100	Gen. Elec.		1100/1800
200	Gen. Elec.	MD	300/450
700	Gen. Elec.	MPC	450/600

BOILERS

100—HP Scotch Marine 100#
2—500 HP B & W 150# ASME
2—750 HP Edgemoor 175#
3—361 HP B & W Stirling
1—516 HP B & W 20#, stoker
2—250 HP Union, Taylor stoker
3—400 HP B & W Stirling 200#
3—308 HP Heine ASME 180#
1—518 HP Heine 180# ASME

CONVERTER

165 Gen. Elec. type HCC-6-165 form P, 6 ph. 60 cy. 1200 RPM AC to 125/250 V. D.C. comp. intp. with transf. & sw. gear.

SQUIRREL CAGE

1	75	Al. Ch.	AN	600
3	75	Al. Ch.	345	
5	75	G.E.		600
1	100	Al. Ch.		1800
1	100	Al. Ch., vert.		1200
3	100	Westg., 2200/220/440	CS	1200
1	100	West. El.	KT	900
1	100	G.E., 2200 v.	IK	900
1	100	Al. Ch., 2200 v.		450
2	125	G.E., 2200 v.	KT547	1800
2	125	G.E., 2200 v.	KTP	1800
1	125	G.E.	KT	720
1	150	Westg., 2200 v.	CS	1710
1	150	Al. Ch.		1200
1	150	G.E.	K-558	900
1	150	Westg., 2200 v.	CS	1800
1	150	G.E.	IK	600
2	150	Westg.	CCL	495
1	200	Westg.	CS	3600
3	200	F. Morse, B.B.		1800
1	200	G.E., 2200 v.	KT	1800
1	200	G.E.	IK	1200
1	200	G.E.	IK	600
1	200	Westg.	CS	600
1	225	G.E., 4160 v.	FT	3600
1	225	G.E., 2200	I-E	1800
4	250	Fair, M.B.B., 2200 v.		1800
1	250	Ideal	A	1200
1	250	F. Morse B.B.	3-brg.	900
2	400	G.E., 2200 v.	I-K	1800
1	400	Al. Ch.		600
1	700	G.E., 2200, drip-proof constr.	KF	1800
1	1000	G.E., 2200 v.	K	600

CHICAGO ELECTRIC CO. 1320 W. CERMAK RD. CANAL 2900 CHICAGO 8, ILL.

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.

1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 6000 KVA Westinghouse Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
1— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA Allis Chalmers Cond.
1— 2500 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 General Electric Cond.
1— 1500 KVA Allis Chalmers Non-C.
2— 1250 KVA General Electric Non-C.
1— 938 KVA West. 375# I.P. 100# B.P. N-C.
1— 625 KVA General Electric Non-C.
1— 470 KVA Westinghouse Non-C.
1— 312 KVA Moore Non-Condensing
1— 250 KVA Westinghouse Non-C.
1— 125 Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 340 KVA Skinner Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 250 KVA Ridgway 4-valve
1— 210 KVA Skinner Uniflow
1— 94 KVA Chuse Uniflow

D.C. STEAM ENGINE UNITS

1—350 KW Ridgway 4-valve 250-V.
1—300 KW Skinner Uniflow 250 V.
1—250 KW Ames Uniflow 250 V.
1—200 KW Ridgway 4-valve 250 V. 3-wire
1—150 KW Ames Uniflow 125 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Ames Uniflow 120 V.
1—100 KW Elliott 4-valve 250 V. 3-wire
1— 50 KW Ames Uniflow 125/250 V. 3-wire

OIL & GAS ENGINE UNITS—60 Cy.

1—500 KVA West. (gas) 440 V.
1—330 KVA DeLaVergne 2300 V.
1—312 KVA Anderson 2400 V.
1—200 KW Worthington 2300 V.
1—200 KVA Fairbanks Morse VA 2400 V.
1—187 KVA McInt.-Seymour 2300 V.
1—125 KVA Sterling Petrel (gas) 480 V.
1—121 KVA Fairbanks Morse 240 V.
1— 57.7 KVA Fairbanks Morse 240 V.
1— 37.7 KVA Caterpillar 120/208 V.

SURFACE CONDENSERS

1—20,000 sq. ft. Worthington
1—12,000 sq. ft. Worthington
1— 5,000 sq. ft. Westinghouse
1— 4,100 sq. ft. Ross
1— 2,310 sq. ft. Wheeler C. & E.

WATER TUBE BOILERS

1—750 HP Edge Moor 200-lb.
1—612 HP Stirling 250-lb., Pulverizer
2—560 HP Erie City 460-lb.
1—500 HP Stirling 250-lb., Stoker
1—500 HP Stirling 200-lb., Stoker
1—440 HP B. & W. 160-lb., Hand Fired
1—400 HP Wickes 200-lb., Stoker
1—335 HP B. & W. 200-lb., McClave-Brooks Stoker
4—200 HP B. & W. 200-lb., Hand Fired

A. C. GENERATORS

2—1500 KVA G. E. 25 cy. 2200 V. 750 RPM
2—1250 KVA G. E. 60 cy. 480 V. 750 RPM
1— 750 KVA G. E. 60 cy. 230-460 V. 300 RPM
1— 680 KVA G. E. 25 cy. 13200-4000 V. 300 RPM
1— 500 KVA G. E. 60 cy. 2300 V. 360 RPM
1— 360 KVA West. 60 cy. 240 V. 360 RPM
1— 94 KVA G. E. 60 cy. 2300 V. 600 RPM
1— 48 KW Elec. Mcy. 60 cy. 2400 V. 1200 RPM

SYNCHRONOUS MOTORS

2—1250 HP G. E. 25 cy. 2200 V. 750 RPM
2—1125 HP G. E. 60 Cy. 480 V. 720 RPM
1— 850 HP G. E. 25 Cy. 13200-4000 V. 300 RPM
1— 800 HP G. E. 60 Cy. 440 V. 120 RPM
1— 770 HP G. E. 60 cy. 230-460 V. 300 RPM
2— 300 HP G. E. 60 Cy. 220/440 V. 600RPM
1— 150 HP Al. Ch. 60 Cy. 440 V. 257 RPM
1— 100 HP G. E. 60 Cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

4—3500 PH G. E. slip ring 2300 V. 120 RPM
1— 600 HP G. E. sq. cage 440 V. 900 RPM
2— 400 HP G. E. slip ring 3800 V. 1800 RPM
2— 300 HP G. E. sq. cage 440 V. 600 RPM
2— 250 HP G. E. sq. cage 2300/4000 V. 1200 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW General Electric 600 V. DC
1—1500 KW Westinghouse 250 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 500 KW General Electric 250 V. DC
1— 75 KW General Electric 125 V. DC
2— 70 KW General Electric 125 V. DC

ROTARIES—60 Cy.

1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
2— 750 KW General Electric 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

FREQUENCY CHANGERS

2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA G. E. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1875 KVA G. E. 25/60 cy. 300 RPM
2—1250 KVA G. E. 25/62½ cy. 750 RPM
1—1250 KVA G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 60/25 cy. 300 RPM

SYN. CONDENSERS—60 Cy.

1—5000 KVA West. 5000 V. 720 RPM
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
2—1250 KVA G. E. 480 V. 750 RPM
1— 750 KVA G. E. 230-460 V. 300 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.

1—10000 KVA West. 120,000/66000-13200 V. 3 ph.
3— 750 KVA Pitts. 66000/33000 V.
3— 200 KVA G. E. 66000-13200/22800 V.
6— 250 KVA Penn. 34500-4600/2300 V.
3— 75 KVA G. E. 33000-13200/11000 V.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
1— 6000 KVA West. 13200-2300 V. 3 ph.
3—1500 KVA Pitts. 22000-6600 V.
2— 1000 KVA G. E. 23000/11500-575 V.
6— 833 KVA G. E. 22000-2300/4000 Y V.
3— 667 KVA Packard 23000-440 V.
3— 250 KVA G. E. 22000-11000 V.
6—1667 KVA Pitts. 13200-2300 V.
5— 1000 KVA G. E. 13200-2300 V.
3— 200 KVA G. E. 13200-2300 V.
7— 667 KVA Moloney 11000-2300 V.
3— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3—1250 KVA G. E. 6600-550 V.
3— 667 KVA G. E. 2300/4000Y-500/480/460 V.
5— 100 KVA G. E. 2300-230/460 V.

VOLTAGE REGULATORS
60 Cycle Induction

6—96 KVA 400 A. 2400 V. Gen. Elec.
1—72 KVA 300 A. 2400 V. Gen. Elec.
2—48 KVA 200 A. 2300 V. West.
6—36 KVA 150 A. 2400 V. Gen. Elec.
6—24 KVA 100 A. 2400 V. Gen. Elec.

OIL CIRCUIT BREAKERS

2— 600 A. 73 KV West. G222AS Outdoor
2— 400 A. 73 KV G. E. FKO36 Outdoor
1— 400 A. 73 KV G. E. FHKO36 Outdoor
6— 400 A. 37 KV G. E. FHKO136 Outdoor
4— 400 A. 34.5 KV Condit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
4— 600 A. 15 KV G. E. FKO60B Outdoor
2— 400 A. 15 KV G. E. FHKO136 Outdoor
1—2000 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV West. E6 Indoor
2—1500 A. 15 KV G. E. FK12 Indoor
3— 600 A. 15 KV G. E. FK32C Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 CHURCH STREET, NEW YORK CITY 7, NEW YORK

FOR SALE

1—150 HP Full Diesel—Fine Cond.
1—50,000 & 70,000 Gallon Tanks on Towers
1—10 Ton O.E.T. Crane, 95' Span
1—300 KW AC Gen. D/C 4 Val. Engine
1—60 HP. 125# Vertical Boiler
2—72 x 18, 175# H.R.T. Boilers
Tractors, Air Compressors, Hoists, Etc.

When Buying or Selling Equipment, Always Try

H. & P. MACHINERY CO., St. Louis, 6719 Etzel

DIESEL Units For Sale

15 HP G.M. 1200 RPM, 240v.
50 HP Buda, 1200 RPM. 220v.
112 HP Buckeye 400 RPM. 240v.
and others

STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., New York N. Y.

FOR SALE

250 K.W. G.E. A.C. GENERATOR type ATI-32-312M-225, Form S. 225 RPM, P.F. .8, 75.5 amps., 3/60/2300 volt. Pedestal sole plates. Includes G.E. exciter 17½ KW, type RC compound wound & switchboard.

ALJON ELECTRIC DIESEL CO.
151-55 Washington St. B'klyn, N. Y.
Main 4—3804—5

---

120 KW ENGINE GENERATOR SET

1—120 KW G.E. Co. Type TRE Generator, 3/60/2300 volts, direct connected to 125# Harrisburg Fleming Steam Engine.

HOIST

1—50 HP Lidgerwood Double Drum Hoist, 24 x 24" drums, side by side, with or without AC or DC motor.

DEEP WELL PUMPS

2—600 GPM, 116 ft. head, Kingsford, size #4 Deep well Pumps with 40 HP G. E. Co. Type CD-93, 230 V. DC vertical motors.

TURBO COMPRESSOR

1—675 C.F.M., 24 Oz. Press. Spencer Turbo Compressor, requires 7½ HP, 1700 RPM Motor.

ELECTRIC EQUIPMENT
FOR
INDUSTRY

LET US KNOW YOUR REQUIREMENTS

REBUILT & GUARANTEED STOCK
MOTORS, D.C. & A.C. TRANSFORMERS
MOTOR GENERATOR SETS
ROTARY CONVERTERS
SWITCHBOARDS BUILT TO ORDER

SYNCHRONOUS MOTORS

2—150 HP W.E. Co. Type G, 80% P.F. for 3/60/220-440 volts, 1200 RPM, with direct connected exciters.
2—250 HP W.E. Co. Type HR, 100% P.F. for 3/60/2300 volts, Engine Type, one (1) at 240 RPM, one (1) at 277 RPM.

100 KW ROTARY CONVERTER

1—100 KW G.E. Co. Type TCC for 250 V—DC and 3/60/2300 V—AC. Transformer and Switchgear, 1200 RPM.

CENTRIFUGAL PUMPS

2—2700 GPM, 170 ft. head Lecourtnay Centrifugal Pumps driven by 150 HP W.E. Co. Type G, 80% P.F. Synch. motors 3/60/220-440 volts, 1200 RPM.

PLATFORM SCALE

1—15 ton Fairbanks Industrial Platform Scale, 5' x 8'.

FREQUENCY CHANGERS — TURBO GENERATORS — AC & DC MANUAL MAGNETIC CONTROL — CENTRIFUGAL PUMPS — AC & DC SWITCHBOARDS

FOR DETAILS, WRITE **JOHN D. CRAWBUCK CO.** 714-15 EMPIRE BLDG. PITTSBURGH, PENN.

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS

6250 KVA G.E. 2300 V., cond.
4000 KVA Al. Chal. 2300 V. cond.
3125 KVA G.E. 4100/2300 V. cond.
2500 KVA G. E. 2300 V. cond.
2500 KVA Al. Chal. 440 V., cond.
1875 KVA Al. Chal. 2300 V. cond.
1250 KVA (2) G. E. 2300 V. cond.
940 KVA Wghse. 6600 V. cond.
937 KVA G. E. Auto BLEEDER, 2300 V.
937 KVA G. E. 2300 V., cond.
937 KVA Al. Chal. 2300 V., 300#.
780 KVA Al. Chal. 2300 V., cond.
625 KVA Wghse. 2300 V., cond.
375 KVA G. E. 2300 V., cond.
312 KVA Elliott 480 V., cond.
250 KVA Al. Chal. 480 V. Auto BLEEDER.
150 KVA Wghse, 240 V. cond. (Non-Cond.)
375 KVA G.E. 2300 V.
312 KVA C.W.—Moore, 450#, 240 V.
175 KVA Al. Chal.—Sturtevant 220 V.
75 KVA Al. Chal., 240 V.

STEAM ENGINE SETS (A C)

500 KVA (2) G. E.—24 x 48 Bates Corliss.
490 KVA Wghse.—Hamilton Cross Comp.
420 KVA Wghse.—Erie Ball Cross comp.
375 KVA G. E.—22 x 27 Erie Ball, 4 V.
210 KVA G. E.—19 x 20 Skinner Unif.
150 KVA G. E.—16 x 15 Skinner Unif.
150 KVA G. E.—16 x 36 Skinner S. V.
125 KVA G. E.—12 x 21 Hamilton 4 V.
100 KVA G. E.—14 x 15 Skinner Unif.

DIESEL ENGINE SETS

500 KVA Wghse.—Busch Sulzer
375 KVA Wghse.—Busch Sulzer
312 KVA G. E.—Anderson
312 KVA G. E.—McIntosh Sey.
200 KVA G. E.—Busch Sulzer
170 KVA F. M.—F. M. "VA"
140 KVA E. M.—Fairbanks Morse "V"
121 KVA F. M.—F. M., 32-E
100 KVA C. W.—Bessemer
90 KVA (4) F. M.—F. M. "VA"
75 KVA C. W.—Caterpillar
75 KVA Al. Chal.—International
58 KVA F. M.—F. M. 32-E
50 KVA F. M.—F. M. 6 cyl.
38 KVA C. W.—Caterpillar
32 KVA F. M.—F. M., 6 cyl.

SPECIAL

937 KVA G. E. 3-60-2300 V., Auto BLEEDER. With complete equipment.
937 KVA G. E. 3-60-2300 V., Condensing. With complete equipment.

W T BOILERS

749 HP (2) Edgemoor, 200#
728 HP Erie City, Ver. 200#
600 HP Connelly, 200#
600 HP Heine, 200#
522 HP Sterling, 207#
471 HP Erie City Ver., 160#
396 HP B.&W., 160#
264 HP B.&W. (heating)
250 HP Sterling, 160#
200 HP (2) Scotch Marine, 15#

PUMPS (MOTOR DRIVEN)

7500 GPM, 80' head
4000 GPM 70' head
3600 GPM 85' head
3250 GPM 425' head
3000 GPM 100' head
3000 GPM (2) 65' head
1390 GPM 231' head
850 GPM 243' head
750 GPM Hill 231' head
650 GPM 810' head
350 GPM 720' head

STEAM ENGINE SETS (D C)

450 KW C. W. 250 V.—Nordberg Unif.
300 KW G. E.—Skinner Unif.
150 KW G. E.—Erie Ball 4 V.
100 KW G. E.—Erie Ball 4 V.

AIR COMPRESSORS

2200 CFM Nordberg 100#, steam and motor driven
1080 CFM Nordberg 85#.—motor Steam driven—all sizes
Gas driven—80-100 HP, 200/300#

TRANSFORMERS

687 KVA (2) Maloney 13800-460 V.
500 KVA (3) Al. Chal. 33000-440 V.
500 KVA (2) G. E. 11950/6900-230/460 V.
250 KVA (2) G. E. 6600-2300 V.
150 KVA (2) Maloney 2300-230/460 V.
150 KVA (2) Furnace Type 6600-90
100 KVA (3) Al. Chal. 22000-440 V.
100 KVA (2) G. E. 13200/6600-440/600 V. & small sizes.
3 Ph. Transformers
750 KVA Wagner 6600-2200 V.
500 KVA (4) G. E. 13200-120/208 V.
300 KVA (2) G. E. 13200-120/208 V.

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

3 PHASE, 60 Cycle, 220/440 V.

HP	Make	RPM	Type	Frame
7½	Gen. Elect.	1200	KT	952
10	Gen. Elect.	720	K	404
10	Gen. Elect.	900	KT	312
15	West.	1800	CS	
20	Gen. Elect.	900	KG	405
20	Armor	900	ball bearing	
20	Fairbanks Morse	900	ball bearing	
20	Fairbanks Morse	1200 600	two speed	
25	Westinghouse	900	CS	444
30	Armor 2-phase	720	ball bearing	
40	Westinghouse	1800	CS	
50	Gen. Elect.	1800	IK	
50	Westinghouse	900	CS	505
50	Westinghouse	900	CS	646A
50	West.	1800	CS	
60	Gen. Elect.	1800	I	form K
75	Gen. Elect.	1800	I	form K
75	Gen. Elect.	900	KT	552
100	Gen. Elect.	1800	I	form K
100	West.	1800	CS	
150	Gen. Elect.	1200	I	form K
150	Gen. Elect.	1200	I	form K

TRANSFORMERS

Amt.	Kva.	Make	Cycle	Voltages
3	25	Gen. Elect.	25	2300/115/230
3	50	Gen. Elect.	25	2300/115/230
3	75	Gen. Elect.	60	4600/230/460
3	100	Gen. Elect.	25	2300/115/230/460
2	150	Westinghouse	25	2300/115/230/460
3	200	Gen. Elect.	60	2300/230/460
3	250	Gen. Elect.	60	13,000/2300
3	250	Westinghouse	60	11500/460
2	333	Westinghouse	60	2300/230/460
3	500	Pittsburgh	25	11,000/220
4	833	Allis Chalmers	60	13,200/440
3	1000	Pittsburgh	60	2300/4600/230/460

SPECIAL

3—250 KVA. Westinghouse Transformers Type SL 11,500 volts Primary 460 volts. Secondary, 60 cycle 1 phase. Used less than 1 year.

Mine Slope Hoist

1—Connellsville Mfg. and Mine Supply Hoist storage capacity for 11,000 feet 1" Rope—Speed 900' per minute.
Motor—500 HP Gen. Elec. Mt. Slipring 3/60/2200/450 RPM. Complete with remote control, Herringbone reduction gears and demountable base and drum.
Write Wire Phone
Inspection can be made for 30 days in operation. This machine almost new.

MOTOR GENERATOR SETS

1—125 KW Ridgeway 250 V. DC. 1200 RPM Motor 3/440/60/1200 Complete.
1—100 KW Westinghouse Synchronous-Generator 250-275 V. DC—Motor 3/60/2300/900 RPM complete with panels.
1—150 KW Westinghouse Synchronous-Generator 250-275 V. DC. Motor 3/60/2300/900 RPM complete with panels.

3 PHASE, 25 CYCLE, 220/440 VOLTS

HP	Make	RPM	Type	Frame
5	Al. Chal.	720	AR	
5	Wagner	1450	Ball B.	Enclosed
7½	West.	750	CS	
7½	G.E.	1500	KT	181
10	G.E.	750	KT	312
10	West.	750	CS	
10	West.	1500	CS	
10	G.E.	1500	I	Form K
15	G.E.	750	KT	
15	West.	1500	CS	
20	West.	750	CS	
25	West.	750	CS	
50	G.E.	750	I	Form K
50	West.	750	CS	
75	G.E.	750	KT	357
75	G.E.	750	I	Form K
100	G.E.	300	I 17	Form K
150	G.E.	750	I	Form K
150	G.E.	750	I	Form K
200	West.	460	CS	2200 Volt
200	G.E.	750	I	Form K
225	Elec. Ma.	500	2200 V.	Synchron
1150	G.E.	375	2300 V.	Synchron
200	West.	235	CW	Slipring

Prices on Application

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

HP	Make	Speed	Type	Frame
10	Gen. Elect.	1800	MT	303
15	Gen. Elect.	1800	I	form M
20	Gen. Elect.	545	MT	332
20	Westinghouse	575	CW	648A
20	Westinghouse	575	CW	ball bearing
25	Westinghouse	690	CW	
30	Gen. Elect.	1800	MT	327
30	Gen. Elect.	1800	I	form M
40	Westinghouse	690	CW	748
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
50	Westinghouse	900	CW	
60	Westinghouse	720	CW	2200 volt
75	Westinghouse	1800	CW	
500	Westinghouse	600	CW	

SPECIAL

2—500 HP. Gen. Elec. Motors, Type I, Form K, 3/60/440/900 RPM, with Starting Compensators.
1—500 HP. Gen. Elec. Motor, Type KTP, 3/60/440/1200 RPM with Starting Compensator.

2—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM. direct connected to Generator 3/62½/440 V. Complete with exciters and panels.
1—200 KW General Electric 3 ph., 60 cy., 2300 V. direct connected to 290 HP. Gen. Elec. Synchronous Motor, 3 ph., 25 cy., 440 volt, 750 RPM. Complete with panels.

150 HP D.C. MOTOR

150 HP. Westinghouse Type SK, 180L, 230 V., 1100 RPM, Compound Interpole. Serial No. 2221504.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

1—400 HP Westinghouse, type CW, 3 ph. 60 cy, 440V, 430 RPM slip ring motor

1—250 HP General Electric, 3 ph, 60 cy, 440V, 1-17 400 RPM

1—200 HP Allis Chalmers, 3-60-440V, 514 RPM

1—150 HP Allis Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring

1—150 HP Electric Mach. syn. motor, 125 KVA, 3-60-220V, 1200 RPM

1—150 HP General Electric, 3-60-440V frames 17A 360 RPM slip ring

1—150 HP Westinghouse, 2 ph, 60 cy, 440V frame 1000, CW. 390 RPM slip ring

4—100 HP General Electric, 3-60-440V, 495 RPM, MT 562 slip ring

2—100 HP General Electric type I, form K, 3-60-220V 575 RPM

50 KW Westinghouse, 125/250 V, type SK, frame 160, 3 wire generator direct connected to a 100 HP General Electric, type KT356, 900 RPM, 3 PH, 60 CY, 220 V motor on fabricated base.

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200V, 1750 RPM, Squirrel Cage

1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 690 RPM slip ring

1—100 HP G. E., 3 ph, 60 cy, 440V, 580 RPM, type I-M slip ring

1—100 HP General Electric, 3 ph, 60 cy, 4000V, 720 RPM syn., type TS with direct connected exciter

2—100 HP Crocker Wheeler, size 2AQ, 3 ph, 60 cy, 440V, 385 RPM slip ring

1—100 HP Westinghouse, type CS, 3 ph, 60 cy, 440V, 1750 RPM sq. cage

2—75 HP 300 foot head Pumps: 2200V Fairbanks-Morse, 1800 RPM 3 ph, 60 cy, slip ring motors direct connected to 500 GPM 3 stage

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V 450 RPM slip ring

1—75 HP Fairbanks-Morse, type H, frame 165C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage

1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 600 RPM slip ring

1—75 HP General Electric, 3 ph, 60 cy, 440V, 600 RPM, MT558 slip ring

1—75 HP Western Elec. type I, 3-60-440V, 690 RPM

2—75 HP Allis Chalmers, 3 ph, 60 cy, 440V, 860 RPM slip ring

1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage, 900 RPM

1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K

1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring

1—60 HP Westinghouse, 3 ph, 60 cy, 220V, 1160 RPM, type CS-644C

1—50 HP Wagner (Fynn Weichsel) 3-60-440V, 1200 RPM

1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring

1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound

1—50 HP General Electric, 3-60-440V, KT-346, 870 RPM, Sq. Cage

1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring

1—50 HP Howell 3-60-440V, 870 RPM, type SCBB ball bearing Sq. Cage

1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage

2—50 HP Allis-Chalmers 3-60-440V, 690 RPM slip ring

1—50 HP General Electric 3-60-440V, 690 RPM, MTS 46, slip ring

1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring

3—50 HP General Electric 3-60-440V, 575 hPM, type I-K, fr. 13A, Sq. Cage

1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage

1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage

1—50 HP General Electric 3-60-440V, 490 RPM, type I-M, slip ring

1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage

1—50 HP Allis-Chalmers, 3 ph, 60 cy, 220V, 1160 RPM, type AR-220D

1—50 HP Howell, 3 ph, 60 cy, 440V, 1165 RPM, type SC50-4, ball bearing

1—50 HP Allis-Chalmers, 3 ph, 60 cy, 550V, 860 RPM sq. cage

1—50 HP General Electric, type I-M, 3 ph, 60 cy, 440V, 720 RPM slip ring

1—45 KVA Fairbanks Morse, 3 ph, 60 cy, 220V, 1200 RPM alternator.

2—30 HP Fairbanks-Morse, 3 ph, 60 cy, 220V, 3600 RPM, type HO, frame 12B ball bearing

1—30 HP, Wagner, 3 ph, 60 cy, 440V, 900 RPM, type 19TCM, totally enclosed fan cooled, ball bearing

We have a stock of 3000 motors from 1 HP to 50 HP in AC and DC. We have a very large stock of air circuit breakers up to 12000 amp.

2—175 HP, 230V, DC Westinghouse, type SK, 525 RPM

1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM

1—60 HP Westinghouse, type SK, frame 160, 230V, 880 RPM

1—60 HP Westinghouse, type SK140L, 115V, 1150 RPM vertical

1—50 HP Westinghouse, type SK, fr. 160, 230V, 565 RPM

1—50 HP Westinghouse SK200, 245 RPM, 230V

1—DC Generaor 45KW Bullock, 120V, 375A, 900 RPM

2—40 HP C & C 230V, 250/1000 (planer)

2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-13A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25 cy-440V, 720 RPM, type MS, Sq. Cage

1—50 HP General Electric, 3-25 cy-440V, 700 RPM, type I-M, slip ring

1—40 HP Westinghouse 3-25 cy-440V, 730 RPM, type CI, frame 753A slip ring crane

1—35 HP Allis-Chalmers 3-25 cy-440V, 720 RPM, slip ring

1—30 HP Westinghouse 3-25 cy-440V, 720 RPM, CS. Sq. Cage

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1—3125—KVA GE 3/60/2300V, 200#
2—1875—KVA GE 3/60/2300V, 200#
1—1000—KW, DC, West. 3/60/250; 135/200#
2—937—KVA Allis-Chal. 3/60/2300:200#
1—250—KVA GE. Non-Cond. 3/60/480

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500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
200 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

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200 KW G.E. SYN. 250 V. 2300/4000 A.C. 1200 RPM
200 KW G.E. IND. 600 V. 2300/4000 A.C. 1200 RPM
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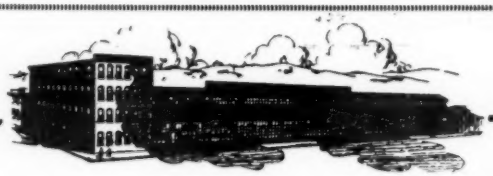

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SLIP RING MOTORS, 3 PH., 60-CY.

HP	Volts	Make	Speed
900	2200	G.E.	900
800	2300	Whse	514
450	2300	G.E.	600
400 (2)	400	Whse.	514
400	2300	Whse.	1200
350	220–440	G.E.	1800
350	2200	G.E.	600
300	2300–4000	G.E.	1200
250	2300	G.E.	600
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–400	G.E.	600
150	440–220	G.E.	1800
150	2200	G.E.	900
150	440	G.E.	1800
150	550–2200	G.E.	1800
125	440–220	G.E.	600
100	550–2200	G.E.	720
100	440–220	G.E.	1800
100	220–440	G.E.	720
100	220–440	G.E.	900
75	220–440	G.E.	600

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

600	2200	Whse.	900
400	440–220	Whse.	276
350	440–220	G.E.	900
240	2300–440–220	G.E.	600
200	2300–4000	G.E.	1200
150	2200	G.E.	1800
110	440	Whse.	900

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3—250 kva., Whse., 13,800-460.
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3—200 kva., G.E., H-KD 6600-2300/4000Y., 25 cy.
3—175 kva., G.E., 4000-480.
3—150 kva., G.E., type H-KDD 13200/2300.
3—150 kva., Al. Chal., type OISC 10400-2400.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., Whse., 22,000-2300.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120.
3— 50 kva., Whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
550	440/220	G.E.	IK	900
400	440	G.E.	KTP	1200
400	2200	Whse.	C.S.	1800
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	600
200	220/440	G.E.	IK	720
150	2200	Allis. Ch.	AN	450
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E.	K	1800

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75 KW, 125 V, 1200 RPM Westinghouse Conn. to 112 H.P. 2300/440 V, 3 ph, 60 cy. Ind. motor.
1—75 KW 125 V, 1200 RPM, GE Conn to 100 HP 440 V. 3 ph. 60 cy. Ind. motor.
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1—50 KW 250 V. 900 RPM, Whse. SK 607 to 75 HP 440/220 V. 3 ph. 60 cy. Ind.

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1— 732 CFM I.R. 100# Belted
1— 825 CFM 100# Steam Driven
1— 600 CFM 500# Steam Driven
1— 386 CFM I.R. Steam Driven

Centrifugal Compressors

10000 CFM 33# Turbine Driven

Pumps

2—300 GPM 65' Hd. Motor Driven
1—1500 GPM Fire Pump Steam
1—1000 GPM Fire Pump Steam

Engine—Generators

1—600 KW GE 2300 V.

Belted Generators

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1—450 KW GE 360 RPM 600 V.
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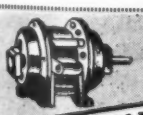

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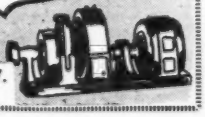

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Large quantity of slow burning cable, conduit and steel pipe available.

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Approximately 300' of 30" flanged, Class C cast iron pipe.

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Large quantity of all type valves from 4" to 30".

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3—500 KVA, General Electric Furnace transformers, 500 KVA, water-cooled, 350 KVA, self-cooled, type HW, single phase, 60 cycle, 2,200 volts primary, 55/110/165/220/330 volts secondary transformers with oil.

2—62½ KVA, 50 KW Fairbanks-Morse, type D, frame D-400-A, 3 phase, 60 cycle, 2,300 volts, 300 RPM, Generators with rheostats.

1—250 GPM, 250 foot head, Allis-Chalmers, 1,750 RPM, Pump, mounted on common base and direct connected to 30 HP. slip ring, 3 phase, 60 cycle, 220/440 volts, 1,750 RPM motor.

1—100 HP. Allis-Chalmers, type ARV, squirrel cage, vertical, 3 phase, 25 cycle, 550 volts, 725 RPM motor.

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Sharp & Ostend St., Baltimore 30, Md.
"Maryland's Most Complete Industrial Electrical Service"

FOR SALE

One Type L, 2-cylinder, 4 cycle, 80 H.P., 720 R.P.M. Foos Full-Diesel Engine, direct connected to a 2300 volt General Electric Alternating Current Generator and Exciter. This engine is in good condition and has been used very little; may be seen at Floridale Hotel site, 13 miles east of Milton, Florida on U. S. Highway No. 90. For further particulars, address: Frank D. Quinn, Owner, 106 East 13th Street, Austin 11, Texas or J. E. Cox, Custodian, Harold, Florida.

For Sale
STOKER

Illinois Forced Draft Chain Grate Stoker with all accessories. Suitable for burning bituminous coal. 150 sq. ft. grate surface. Drive 10 HP coupled to Reeves Drive No. 8. Price $3,000, as is and where is, our plant South Bend, Indiana. Address inquiries to

EMPIRE BOX CORPORATION
Garfield, N. J.

One new Detroit LO Stoker for 150 H.P. 72"x18'-0" fire tube boiler, motor 3 phase, 60 cycle, 230 volt.
One new 50 H.P. G.E. 1200 R.P.M. motor 220-440 volt, 60 cycle, 3 phase and magnetic cross line starter.

FS-626, Power
330 W. 42nd St., New York 18, N. Y.

JUST A FEW ITEMS OF OUR COMPLETE STOCK FOR IMMEDIATE SHIPMENT

PUMPS

G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
2000	40′	Cameron	Centrif.
300	500′	Goulds	Triplex
240	460′	Worth.	Triplex
175	500′	Worth.	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
200	175′	Blackmer	Rotary
1500	460′	Platt	Steam
1000	460′	Knowles	Steam
500	460′	Knowles	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

STEAM ENGINE GENERATOR SETS

BOILER FEED PUMPS

K.W.	Make	Volts	Type
100	Ames	240	dir. dr. Eng.
75	Ames	120–240	dir. dr. Eng.
50	Ball & Wood	125	dir. dr. Eng.
50	G.E.	250	dir. dr. Eng.
35	Sturt.	250	belt dr.
25	Greenfield	115	belt dr.
25	Ball & Wood	125	dir. dr.

MOTORS (D.C.)

100	Northwest.	220	1750
25	Imperial	220	450
25KW	Fair. Morse	110	1050

STORAGE TANKS

5 to 30000 Gal. Steel-welded
5 to 1000 Gal. Steel Press.
15 to 300 Gal. Conden. Tanks

CONDENSATION RETURN UNITS

Nash-Jenn. Dup. Vac. Heat. 26000EDR
Nash-Jenn. Simp. Vac. Heat 16000EDR
Skidmore Vac. Heat. 20000EDR
Skidmore Vac. Heat. 8000EDR
Condensation Units 100 to 250,000EDR

AIR COMPRESSORS

C.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
250	100	Ing. Rand	Horiz.
220	100	Gardner	Gas. Eng.

TURBO-CENTRIFUGAL BLOWERS

3000	16 lbs.	In. Rand	Motor dr.
2300	3 lbs.	Spencer	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24 oz.	Spencer	Motor dr.
400	16 oz.	Spencer	Motor dr.
150	2 lbs.	Allen Billmyer	Motor dr.

BLOWERS

C.F.M.	St. Pres	Makes	Type
100–60000	¼″–5′	Buffalo	Various
100–15000	¼″–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press.	Make	Type
10000	2 lbs.	Roots	Belt dr.
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
200	5 lbs.	Baker	Dir. dr.
110	15 lbs.	Beach R.	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth.	Belt dr.
300	27 in.	Nash	Belt dr.
100	27 in.	Deane	Belt dr.
200	29 in.	Devine	Belt dr.

MOTORS (3 ph. 60 cy.)

H.P.	Make	Volts	Speed	Type
300	G.E.	230/4000	1800	Syn.
200	West.	440	690	HF
175	G.E.	440	1150	I
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	sl. rg.
30	Wagner	220	1150	

STEAM ENGINES

11″x12″ G. E. Vertical
10″x10″ Sturtevant Vertical
10″x10″ Greenfield Vertical
3″x4″ Erie Vertical
7″x7″ Wickes Bros. Vertical
6″x6″ Lawrence Vertical
1 to 25 H.P. Steam Turbines

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HIGHEST PRICES PAID FOR YOUR SURPLUS EQUIPMENT

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Motor Generator Sets—Synchronous Motors, etc.

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1—West. 500 KW, 275 or 600 Volt D.C. 720 RPM, 2300 Volt, 80% P.F. 720 HP, A.C.
1—Allis Chalmers 300 KW, 275 Volt, 600 RPM, 2300 Volt, 80% P.F. 450 HP, A.C.

VERTICAL MOTORS

1—G. E. 50 HP 1200 RPM 3 ph 60 cy 220 V.
1—Reliance Fan-cooled 25 HP 1750 RPM 220/440 V.

SYNCHRONOUS MOTORS
3 phase, 60 cycle, A. C.

1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

SLIP RING MOTORS, 3 phase, 60 cycle

G. E. 60 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

SQUIRREL CAGE MOTORS
3 phase, 60 cycle, 220/440 Volt

1—150 HP 1750 RPM Allis-Chalmers
2—100 HP 550 RPM Westinghouse MS
1— 75 HP 575 RPM Westinghouse CS—368-A
1— 75 HP 600 RPM Fairbanks-Morse
1— 75 HP 720 RPM Lincoln I-P
1— 65 HP 860 RPM Allis-Chalmers
1— 50 HP 1200 RPM Northwestern
1— 50 HP 875 RPM Westinghouse CS
1— 50 HP 865 RPM Ideal
4— 20 HP 870 RPM West. T.E.F.C. CS—W-405
1— 20 HP 870 RPM West. CS—W-405
2— 15 HP 860 RPM Allis-Chalmers

ALTERNATOR SPECIAL, Allis-Chalmers, 125 KVA, 277 RPM, 3 phase, 60 cycle

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DIESEL UNITS

50 H.P. Buda 32 KW, 125 V.D.C.
3—30-40 & 50 KW Gen. Motors 3/60/208 V.
100 H.P. Fairbanks Morse VA Engine.
100 H.P. Wolverine 3/60/480 V.
120 H.P. Muncie 125 V.—D.C.
120 H.P. DeLavergne, 3/60/220 V.
180 H.P. Fairbanks Morse 32E12 Engine.
200 H.P. McIntosh, 3/60/240 V.
250 H.P. Busch Sulzer 4B60 Engine.
285 H.P. Worthington 3/60/440 V.
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Small 3 phase BB synchronized back geared motors.

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1—1052 cubic foot Sullivan type WN31 Air Compressor direct connected to 175 HP 2300 Volt Synchronous Motor complete with all Accessories.
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Large selection—All sizes and types. Generator units, marine engines, gasoline engines, auxiliaries—also boilers, steam engines, turbo generators.

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One 18 x 30″ Heavy Duty Hamilton Corliss Engine arranged for direct connection to 300 KVA A. C. Generator.
One 300 KVA A. C. Generator complete.

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"Fairbanks-Morse" 4 cycle Diesel engine 60 HP 1200 RPM direct connected to Fairbanks-Morse generator, 80 KVA, 50% P.F., 3 phase 60 cycles, 240 volts, complete with switchboard and auxiliaries.

"Superior" 4 cycle Diesel engine 115 HP, 720 RPM direct connected to General Electric generator, 225 KVA, 80% P.F., 3 phase, 60 cycles, 240 volts, complete with switchboard and auxiliaries.

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2—2000 KW **G.E. Rotary Convertors,** HCC, 250/300 Volts D.C. booster type. Each complete throughout. Transformers 4600/2300 v. 3/60. Can be seen running.

1—3000 KVA **Synch. Condenser,** 3/60/2200, 900 RPM. With Transformers, 1/60 22,000/19800 to 2200 volts. Complete, can see running.

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BUCKEYE DIESEL POWER PLANTS

450 H.P.
300 H.P.
225 H.P.
187 H.P.
150 H.P.
112 H.P.
100 H.P.
80 H.P.
60 H.P.
40 H.P.

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Modern Plant doing Modern Rebuilding
From 50 CFM to 3500 CFM

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Engine Generator Unit, American Ball engine 16 x 16 240 H.P. 225 R.P.M. Direct connected to 185 K.V.A. General Electric Generator, 230 V 3 Ph. 60 C. Unit is complete and is in excellent running condition.

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American Taylor Type 37Mc9, 8 retorts, continuous ash discharge, grate area 215 Square Feet, normal capacity 80,000# steam per hour. No priority required, immediate delivery. If interested advise:

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General Electric Engine type with direct connected exciter mounted on flanged shaft, 200 K. W., 3 phase, 277 R. P. M., 240 volts, for diesel engine drive.

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1—Atlas 200 HP, 450 RPM, belted to 150 KVA, 220 volt, 3 phase, 60 cycle generator.

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WANTED

WANTED

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ENGINE WANTED

D.C. 115 Volt 300 K.W. Steam Engine Generator Unit for 140# Boiler Pressure and 18# Back Pressure.

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330 W. 42nd St., New York 18, N. Y.

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TURBO-GENERATOR

7500 kw. 5000 volt. 200 p.s.i. 500° F surface condenser and auxiliaries

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100,000 lbs. per hr. 250 p.s.i. 525° F

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300 Horsepower High speed steam engine, right-hand fly wheel.
200 to 300 Horsepower steam turbine.
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Ridgeway Engine Generator Set, Slide Valve 75 KW, 125/250 volt, 275 R.P.M. 300 Amp. 1076-L.B.T. 30612
1—36" **Ludlow Gate Valve,** non-rising stem 12" bottom outline
2—**Ball steam engines,** 500 h.p. Tandem Slide Valve, direct connected, to 280 K.W. General Electric 2300 volt—3 phase 60 cycle A.C. Generator
1—**Bigelow Boiler**—550 h.p. 250 lbs. pressure, equipped with Stowe chain grate stoker—forced and induced draft fans, water walls and Bayer soot blower.

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Departmental Staff

POWER
330 W. 42nd St., New York 18, N. Y.

1 Solid one-piece construction —eliminates joints; presents smooth, unbroken surface to the fire.

2 A tight seal against the boiler shell—no short circuiting of furnace gases; protection for the rivets.

3 Arches and openings can be moulded to any desired shape or contour. Avoids delays for special tile shapes.

4 Walls securely anchored into place. Patented Flexo-Anchors tie Plibrico lining to exterior walls.

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Stand the Gaff

"ALL-OUT" production requires continuous operation, increased boiler ratings, higher furnace temperatures. Furnace linings must take punishment far beyond ordinary service.

This is where Plibrico linings prove their stamina. Minus the weakness of joints, this one-piece lining can stand the extra strain far better than laid-up fire brick. Furthermore, a Plibrico lining can be more readily and economically repaired.

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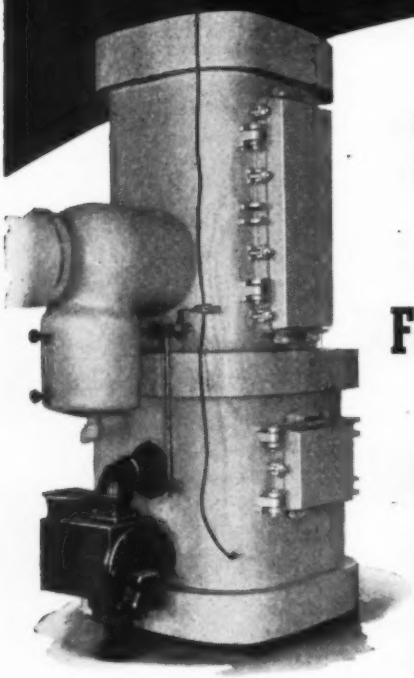

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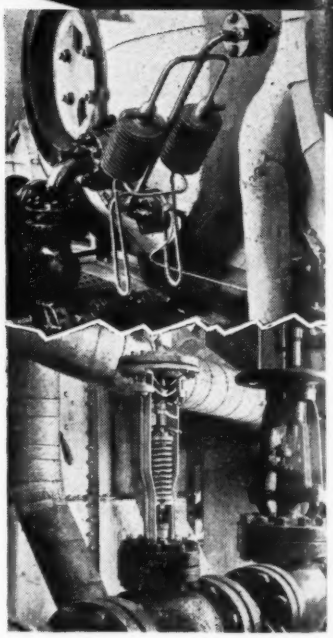

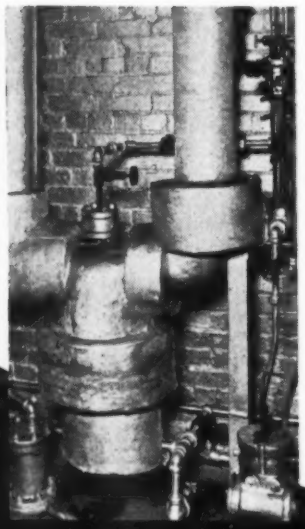

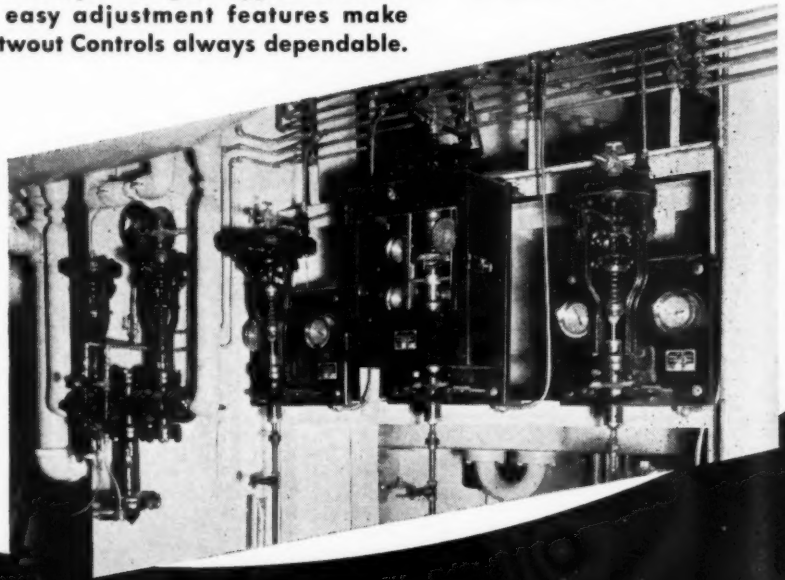

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